

**VIRGINIA DEPARTMENT OF RAIL AND PUBLIC  
TRANSPORTATION**

**CRYSTAL CITY/POTOMAC YARD CORRIDOR  
TRANSIT ALTERNATIVES ANALYSIS**

**FINAL REPORT**

**March 2003**

**HNTB Corporation**

**in association with**

**Transcore, Inc.  
Straughan Environmental Services, Inc.  
Travesky & Associates, Ltd.  
Parsons Transportation Group**

## TABLE OF CONTENTS

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SECTION	PAGE
<b>S EXECUTIVE SUMMARY</b>	
<b>S-1</b>	
<b>1 PROJECT OVERVIEW</b>	<b>1-1</b>
1.1 REPORT OVERVIEW	1-1
1.2 STUDY ORIGINS	1-3
1.3 STUDY METHODOLOGY	1-5
1.4 PUBLIC PARTICIPATION	1-9
1.4.a. Technical and Policy Advisory Committees	1-9
1.4.b. General Public	1-11
1.5 PROJECT DEVELOPMENT	1-13
<b>2 PROJECT PURPOSE AND NEED</b>	<b>2-1</b>
2.1 PROJECT PURPOSE	2-1
2.2 PURPOSE AND NEED STATEMENT	2-1
2.2.a. Purpose	2-2
2.2.b. Significance Of The Crystal City/Potomac Yard Corridor	2-3
2.2.c. Project Goals	2-4
<b>3 STUDY AREA</b>	<b>3-1</b>
3.1 DESCRIPTION OF STUDY AREA	3-1
3.1.a. Existing Road Network	3-6
3.1.b. Existing Rail And Transit Network	3-6
3.1.c. Existing Demographics and Housing	3-8
3.1.d. Existing Development	3-8
3.2 DEVELOPMENT OF POTOMAC YARD AREA	3-9
3.2.a. Development Guidelines	3-9
3.2.b. Future Arlington Potomac Yard North Tract	3-10
3.2.c. Future Arlington Potomac Yard South Tract	3-10
3.2.d. Future Alexandria Potomac Yard	3-12
3.2.e. Future Street System	3-13
3.2.f. Future Transit System	3-15
3.3 ENVIRONMENT FEATURES OF STUDY AREA	3-16
3.3.a. Prime and Unique Farmlands	3-16
3.3.b. Soils	3-17
3.3.c. Rare, Threatened & Endangered Species, Natural Heritage	3-17
3.3.d. Water Resources	3-17
3.3.e. Streams	3-17
3.3.f. Air Quality	3-18
3.3.g. Noise	3-18

SECTION	PAGE
3.3.h. Demographics And Environmental Justice	3-18
3.3.i. Community Facilities	3-19
3.3.j. Cultural And Historic Resources	3-19
3.3.k. Hazardous Material Resources	3-19
<b>4 TRANSIT TECHNOLOGIES</b>	<b>4-1</b>
4.1 BUS RAPID TRANSIT	4-1
4.2 LIGHT RAIL TRANSIT	4-3
4.3 HEAVY RAIL TRANSIT	4-5
4.4 SUMMARY OF KEY CHARACTERISTICS	4-7
<b>5 DEVELOPMENT OF CONCEPTUAL ALTERNATIVES</b>	<b>5-1</b>
5.1 IDENTIFICATION OF TRANSIT-SUPPORTIVE DEVELOPMENT	5-1
5.2. DEVELOPMENT OF TIER 1 ALTERNATIVES	5-2
5.2.a. Tier 1—Study	5-2
5.2.b. Tier 1—Development Of Alternatives By Study Zone	5-4
5.2.c. Tier 1—Description Of Alternatives/Alignments	5-9
5.3 FEEDER BUS NETWORK	5-16
<b>6 TIER 1—ALTERNATIVES EVALUATION</b>	<b>6-1</b>
6.1 TIER 1— EVALUATION CRITERIA	6-1
6.1.a. Ridership Potential	6-2
6.1.b. Transit-supportive Land Use	6-4
6.1.c. Noise Sensitive Areas	6-6
6.2 TIER 1—ADDITIONAL EVALUATION CONSIDERATIONS	6-6
6.2.a. Traffic Engineering Issues	6-8
6.2.b. Congestion Avoidance	6-9
6.2.c. Quality Of Life	6-10
6.2.d. Physical Obstacles	6-10
6.2.e. Department Of Defense Security Concerns	6-11
6.3 TIER 1—ALTERNATIVES SCREENING	6-12
6.3.a. BRT/LRT Alternative	6-13
6.3.b. Metrorail Alternative	6-14
<b>7 TIER 2—ALTERNATIVES DEVELOPMENT</b>	<b>7-1</b>
7.1 STATIONS	7-1
7.1.a. BRT/LRT Station Types	7-1
7.1.b. BRT/LRT Station Guidelines	7-2
7.2 BRT/LRT TYPICAL SECTIONS	7-6

## TABLE OF CONTENTS (continued)

SECTION	PAGE
7.3	POTENTIAL MAINTENANCE FACILITIES
7.3.a.	BRT Maintenance Facility
7.3.b.	LRT Maintenance Facility
7.3.c.	Metrorail Maintenance Facility
7.4	LRT MAINTENANCE YARD EVALUATION
8	TIER 2—EVALUATION
8.1	TIER 2—MEASURES OF EFFECTIVENESS
8.1.a.	Ridership Per Average Weekday
8.1.b.	Number of New Transit Passengers
8.1.c.	Change In Travel Time By Auto
8.1.d.	Change In Travel Time By Transit
8.1.e.	Non-Work Trip Ridership Per Average Weekday
8.1.f.	Peak Hour Trip
8.1.g.	Work Trips
8.1.h.	Transit Mode Share
8.1.i.	Capital Cost
8.1.j.	Operating And Maintenance Cost
8.1.k.	Increase Use Of Metrorail
8.2	TIER 2—EVALUATION OF ALTERNATIVES
8.2.a.	Increase Non-Highway Modes of Travel
8.2.b.	Minimize Adverse Impacts on Commuter Routes
8.2.c.	Increase the Utility of Transit
8.2.d.	Provide Increase Circulation and Mode Choice
8.2.e.	Optimize Use of Financial Resources
8.2.f.	Increase Metrorail Ridership
8.2.g.	Environmental Considerations
8.3	TIER 2—ASSESSMENT OF FEASIBILITY
9	CONCLUSIONS AND RECOMMENDATIONS
9.1	POTENTIAL TRANSIT SOLUTIONS
9.1.a.	LRT Verses BRT
9.1.b.	Metrorail Verses BRT/LRT
9.1.c.	Clark Street Verses Eads Street Alternatives
9.2	STUDY CONCLUSIONS
9.3	STUDY RECOMMENDATIONS
9.4	POLICY ADVISORY COMMITTEE RESOLUTION



## TABLE OF CONTENTS (continued)

SECTION	PAGE
<b>10 ISSUES FOR FUTURE CONSIDERATION</b>	<b>10-1</b>
10.1 TRANSIT FARES	10-1
10.2 VEHICLE PREFERENCE	10-1
10.3 TRAFFIC CAPACITY STUDY	10-1
10.4 FEEDER BUS RATIONALIZATION PLAN	10-2
10.5 EXPANSION, MODIFICATIONS TO TRANSITWAY ALIGNMENT	10-2
10.6 ENHANCEMENTS TO TRANSITWAY PLANNING/DESIGN	10-3
10.7 HEADWAY SENSITIVITY ANALYSIS	10-3
10.8 BRT CONVERSION TO LRT	10-4
<b>11 DEVELOPMENT OF AN INVESTMENT STRATEGY FOR LPA (BRT)</b>	<b>11-1</b>
11.1 COSTS AND REVENUES FOR THE LPA (BRT)	11-2
11.2 COSTS AND FINANCING FOR LPA (BRT)	11-2
11.2.a. Funding Assumptions	11-3
11.2.b. Financing BRT	11-4
11.2.c. Alternative Funding Formula Considerations	11-4
11.3. FINANCING STRATEGY	11-6
11.4 FEDERAL TRANSIT ADMINISTRATION NEW STARTS FUNDING	11-8
11.4.a. New Starts Criteria	11-9
11.4.b. Alternatives Analysis And Preliminary Engineering	11-10
11.4.c. Local Financial Commitment	11-13
11.4.d. Exceptions To The New Starts Criteria	11-13
11.4.e. New Starts Rating And Evaluation	11-13
11.4.f. FTA Project Recommendations	11-14
11.4.g. FTA Ratings	11-15
11.4.h. Funding Availability	11-15
11.5 INNOVATIVE FINANCING	11-16
11.5.a. Public Sector Financing	11-16
11.5.b. Private Sector Financing	11-19
11.5.c. Public-Private Financing	11-20
11.6 ADVACING THE PROJECT	11-21

## LIST OF FIGURES

---

FIGURE	PAGE
S-1 Study Area	S-2
S-2 Alternatives Recommended for Further Study	S-5
S-3 Locally Preferred Alternative	S-9
1-1 Study Area	1-4
1-2 Major Steps in Transit Development	1-6
1-3 Transit Alternatives Development Process	1-7
3-1 Study Area	3-2
3-2 Crystal City & Potomac Yard Proposed Development Plans	3-3
3-3 Potomac Yard Development Plan	3-11
3-4 Potomac Yard Development—Proposed Street System	3-14
5-1 Transit Supportive Use in the Study Area	5-3
5-2 Development Zones Considered in Alternatives Analysis	5-5
5-3 Potential Alignment Alternatives—Southern Development Zones	5-7
5-4 Potential Alignment Alternatives—Northern Development Zones	5-8
5-5 a-c. Tier 1 BRT/LRT Alternatives	5-10/11/12
5-6 Tier 1 Metrorail Alternatives	5-13
6-1 Ridership Potential	6-1
6-2 Transit Supportive Land Use in the Corridor	6-5
6-3 Noise Sensitive Land Use in the Corridor	6-7
6-4 Alternatives Recommended for Further Study	
6-5 Metrorail Alternatives Recommended for Further Study	6-16
11-1 The Three Key Steps of FTA's New Starts Planning and Project Development Process	11-11
B-1 Constrained Long Range Plan Major Highway Improvements	B-5
B-2 Constrained Long Range Plan Major HOV and Transit Improvements	B-9
B-3 Alternate Baseline Projects	B-12
B-4 Existing Bus Services	B-15
B-5 Traffic Signal Priority System	B-17
B-6 Baseline "Lite"	B-21
D-1 Existing Bus Service	D-3
D-2 Additional Peak Period Feeder Bus Routes	D-4
D-3 Additional Midday Feeder Bus Routes	D-5

## LIST OF FIGURES

---

FIGURE	PAGE
G-1 VISSIM Model Components	G-2
G-2 Car-Following Model	G-3
G-3 Intersection being modeled in VISSIM	G-5
G-4 Simulated Potomac Yard Network	G-6
G-5 Crystal City Simulated Network	G-7
I-1 LRT Maintenance Facility	I-11

## LIST OF TABLES

---

TABLE	PAGE
S-1 Approved Development for Potomac Yard & Potomac Greens	S-1
S-2 Measures of Effectiveness	S-4
S-3 Summary of Results	S-6
1-1 Technical Advisory Committee Members	1-10
1-2 Policy Advisory Committee Members	1-11
2-1 Approved Development for Potomac Yard & Potomac Greens	2-2
3-1 Approved Potomac Yard Development Plan	3-5
3-2 Potomac Yard Land Use Descriptions for Figure 3-3	3-13
4-1 Summary of Key Operating Characteristics of Transit Modes	4-7
6-1 Tier 1 Alternatives Evaluation	6-13
7-1 Potential BRT/LRT Maintenance Facility Sites	7-14
8-1 Measures of Effectiveness	8-1
8-2 Tier 2 – Evaluation of Alternatives	8-6
8-3 Crystal City/Potomac Yard Corridor Transit Alternatives Analysis 20-Year Present Value	8-11
9-1 Ridership by Mode of Access	9-5
11-1 Estimated Cost for Preferred Alternative (BRT)	11-2
11-2 Allocation System Costs between Arlington, Alexandria, Virginia, and the Federal Government	11-4
11-3 Allocation Factors for Rail System Capital Costs Based Upon the Metro Compact	11-5
11-4 Allocation Factors for Regional Bus System Capital Costs Based Upon the Metro Compact	11-5
11-5 Allocation Factors for System Operating & Maintenance Based Upon the Metro Compact	11-5
11-6 BRT System Associated Income and Expenditure Yearly Balance	11-6
11-7 BRT System Associated Income and Expenditure Cumulative Totals from 2004	11-8

## LIST OF TABLES

---

TABLE	PAGE
B-1 Summary of Baseline Conditions	B-3
B-2 Highway Projects on the Constrained Long Range Plan	B-6
B-3 Major HOV & Transit Improvements on the Constrained Long-Range Plan	B-10
B-4 Additional State, Local, and Regional Improvements within the Crystal City/ Potomac Yard Study Area	B-13
G-1 Travel Time Changes in the Corridor	G-11

## LIST OF APPENDICES

---

APPENDIX	PAGE
A. Acronyms	A-1
B. Baseline Conditions	B-1
C. Analysis of Land Use Compatibility and Potential Noise Impacts	C-1
D. Feeder Bus Network	D-1
E. Environmental Evaluation	E-1
F. Operational Characteristics	F-1
G. Summary of VISSIM Analysis	G-1
H. Travel Demand Forecasting	H-1
I. Cost Estimate	I-1
J. BRT System Income and Expenditures	J-1
K. Public Participation	K-1
L. Policy Advisory Committee Resolution on the Locally-Preferred Alternative	L-1



## S. EXECUTIVE SUMMARY

The purpose of the Crystal City Potomac Yard Corridor Transit Alternatives Analysis is to investigate transit options for the 5-mile corridor, immediately west of the Potomac River, which runs from the Pentagon in Arlington to the Braddock Road Metrorail Station in Alexandria, Virginia. (The study area is shown in Figure S-1.) The desire for new transit in the corridor stems from increasing population growth in the Northern Virginia region, increasing density throughout the corridor, automobile congestion in the corridor, and the recent approvals for new development in the Potomac Yard site.

Potomac Yard, itself, is one of the largest tracts of close-in, developable land in the United States. Straddling the Alexandria-Arlington line, the Potomac Yard tract contains nearly 400 acres of land in close proximity to Washington, DC, Crystal City, and Old Town Alexandria.

Given the density of the approved development as shown on Table S-1, the proposed pedestrian-oriented design of the development, and the degree of vehicular congestion already present in the corridor, a transportation option focused on transit appears to be a logical means of moving people to and within the corridor. Toward this end, the City of Alexandria and Arlington County asked the Virginia Department of Rail and Public Transportation (DRPT) to undertake a transit alternatives analysis that would explore alternative ways of increasing transit service.

**Table S-1**  
**Approved Development for Potomac Yard & Potomac Greens**

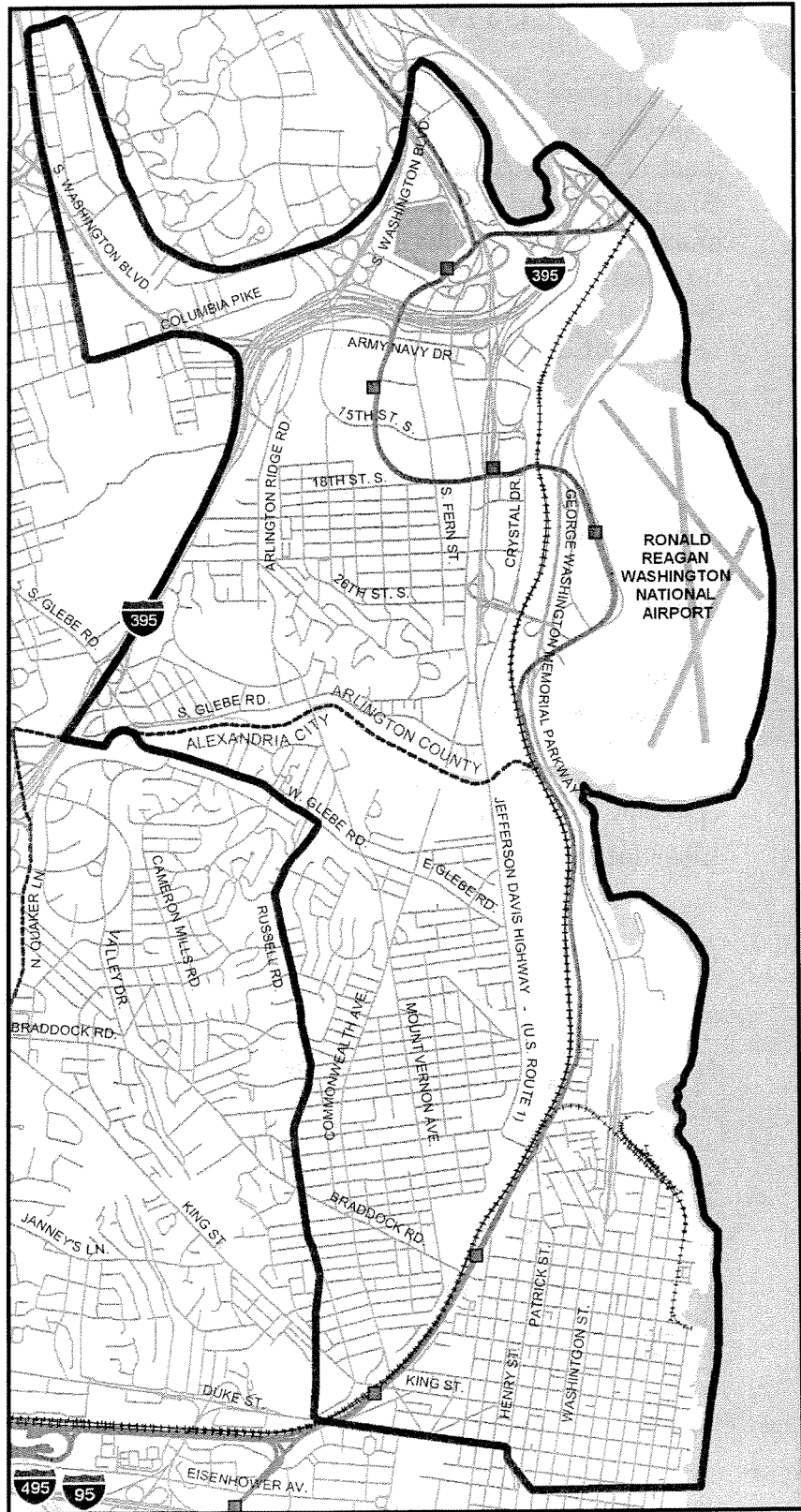
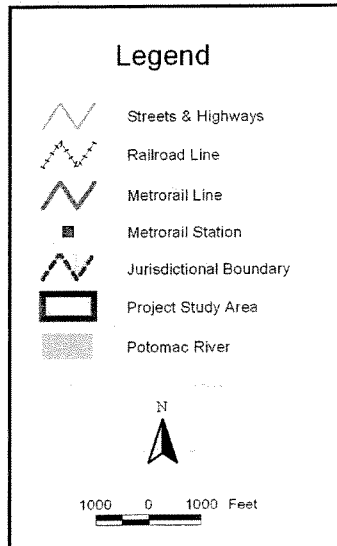
<b>Area</b>	<b>Office (mil. sq. Ft.)</b>	<b>Hotel (units)</b>	<b>Retail (mil. sq. Ft.)</b>	<b>Residential (units)</b>
<b>Alexandria portion</b>	1.90	625	0.735	1,927
<b>Arlington portion</b>	2.88	625	0.060	1,000 <sup>1</sup>
<b>Total – Potomac Yard &amp; Greens</b>	4.78	1,250	0.795	2,927
<b>Other major development proposed within Crystal City</b>	0.44	1,227	0.172	379
<b>TOTAL</b>	5.22	2,477	0.232	3,306

<sup>1</sup> Actual approved development is for 1 million square feet of residential which could result in a range of 800 to 1,200 units depending on size of the units.



# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig S-1  
STUDY AREA



## PROJECT GOALS

As an initial step, the Study Team, in cooperation with City of Alexandria and Arlington County staff, the staffs of other local transportation and planning agencies, locally-elected officials, and the general public, more specifically defined the desire for transit-oriented development in a series of project objectives:

1. Accommodate increasing mobility demands by increasing the capacity of non-highway modes of travel.
2. Minimize adverse impacts of the locally preferred alternative on existing commuter routes in the corridor.
3. Increase the utility of transit and develop transit service and options that support transit as a preferred mode choice for a wide variety of trips beyond morning and evening commuting trips, thereby enabling and promoting a transit-oriented lifestyle.
4. Provide a high level of circulation and mode choice (transit, walking, biking, and auto) within Potomac Yard and between Potomac Yard and surrounding areas.
5. Optimize use of state and local financial resources.
6. Increase the use of the region's existing rail transit system.

Corresponding measures, as shown on Table S-2, were also developed for each of these objectives.

## ALTERNATIVES DEVELOPMENT AND EVALUATION

This study examined three distinct technologies that would supplement and complement the existing transit network in the corridor (bus routes, Metrorail, and Virginia Railway Express). Bus rapid transit (BRT), light rail transit (LRT), and Metrorail in the form of one or more additional stations on the existing Blue and Yellow Lines, were proposed as viable options. Other transit modes, including monorail and other automated guideway technologies (AGT), maglev, and various types of people movers were deemed unsuitable for the corridor and were not analyzed in detail.

The development and analysis of the modal alternatives proceeded in a two-step, or tiered approach.

Initially, the Study Team developed nine separate alignments, on which bus rapid transit or light rail transit might operate. The Study Team also identified sites for two Metrorail stations, between the existing Braddock

Road and Crystal City stations. These initial alternatives were examined in light of several measures including: potential to generate transit ridership; compatibility with existing and proposed land uses in terms of transit-orientation; and potential to have adverse noise impacts on the areas through which the alternatives would pass.

Based upon this initial review, and with substantial public input, four linear alignments (two BRT alternatives and two LRT alternatives) and a two-station Metrorail alternative were advanced for more detailed examination. The five "Tier 2" alternatives are shown in Table S-2. These alternatives were then studied for their ability to achieve the measures of effectiveness established for each of the goals at the beginning of the project.

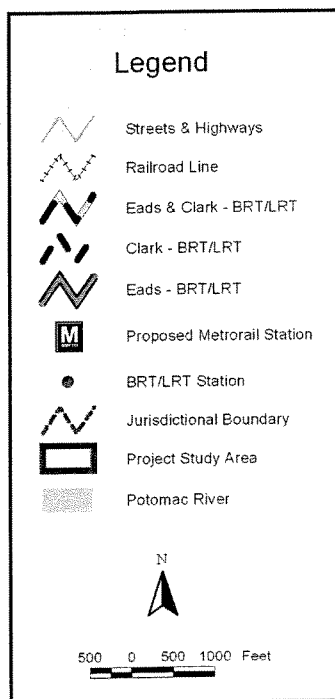
**Table S-2**  
**Measures of Effectiveness**

<b>Measures of Effectiveness by Goal</b>	
<b>Goal 1: Increase non-highway modes of travel</b>	<ul style="list-style-type: none"> <li>• Ridership per average weekday</li> <li>• Number of new transit passengers</li> </ul>
<b>Goal 2: Minimize adverse impacts on commuter routes</b>	<ul style="list-style-type: none"> <li>• Change in travel time by auto</li> <li>• Change in travel time by transit</li> </ul>
<b>Goal 3: Increase the utility of transit</b>	<ul style="list-style-type: none"> <li>• Non-work trip ridership per average weekday</li> <li>• Peak hour trips</li> <li>• Work trips</li> </ul>
<b>Goal 4: Provide increased circulation and mode choice</b>	<ul style="list-style-type: none"> <li>• Transit mode share to the Study Area and selected sub-areas</li> </ul>
<b>Goal 5: Optimize use of financial resources</b>	<ul style="list-style-type: none"> <li>• Construction cost</li> <li>• Operating &amp; maintenance costs</li> </ul>
<b>Goal 6: Increase use of the region's existing rail transit system</b>	<ul style="list-style-type: none"> <li>• Change in Metrorail ridership</li> </ul>

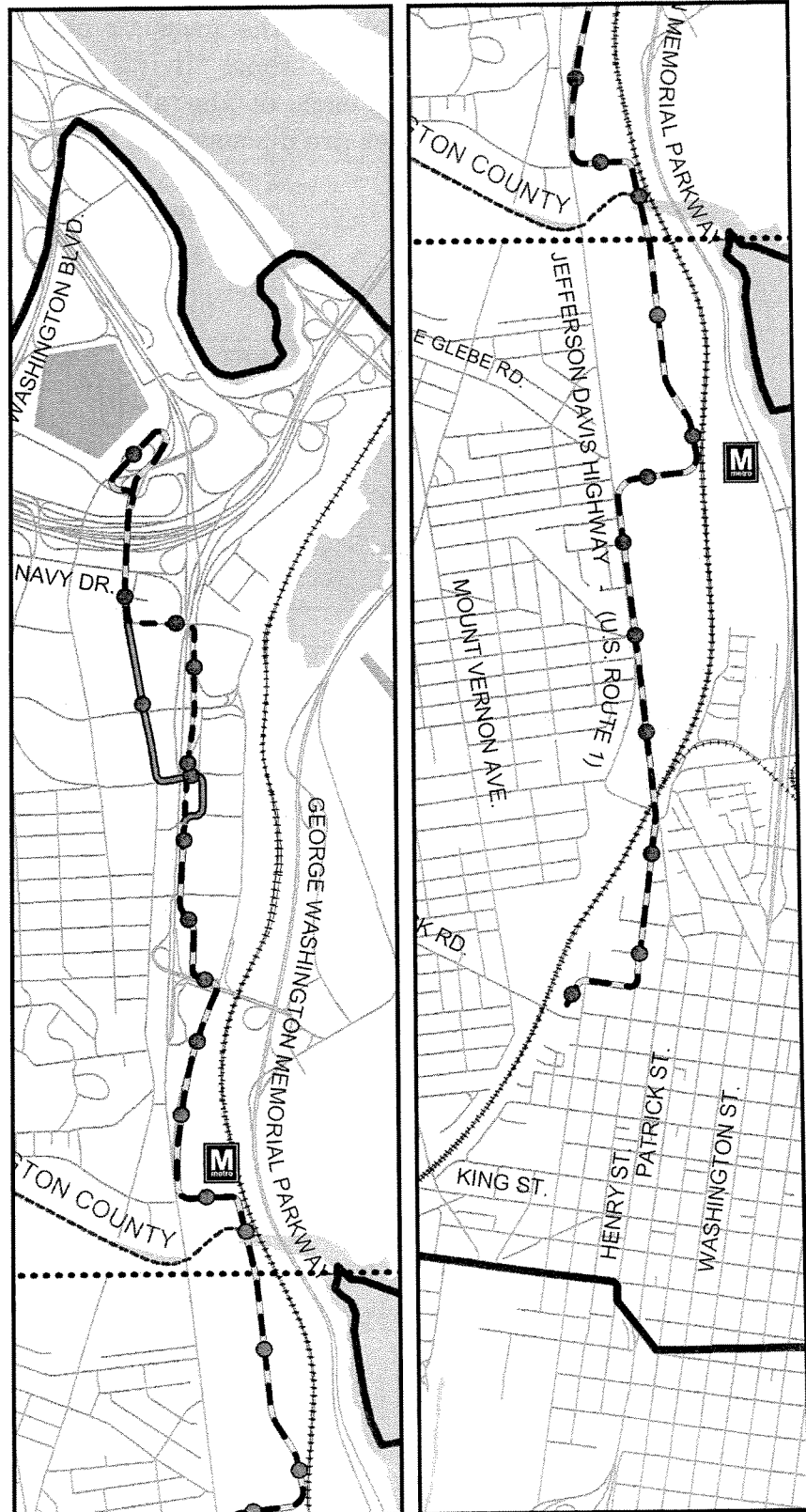
Conceptual engineering cost estimates were prepared both for the capital costs of each project and also the annual operating and maintenance costs. Using the Washington region's Version 2 travel demand forecast model, ridership forecasts were generated and shifts in regional travel from one mode to another were determined. Using the VISSIM traffic simulation software, travel speeds of both the proposed transit operations and general traffic were examined to detect prospective changes in travel times traveling through the corridor.

# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig S-2  
ALTERNATIVES  
RECOMMENDED FOR  
FURTHER STUDY



HNTB



The subsequent analysis, as shown in Table S-3, illustrates that all of the alternatives generally achieve the project's objectives and help to create a transit-oriented lifestyle for those living and working in the proposed development. However, each of the alternatives has differing costs and benefits. These differences are discussed in the study conclusions.

**Table S-3**  
**Summary of Results**

<b>Measure</b>	<b>BRT-Eads</b>	<b>BRT-Clark</b>	<b>LRT-Eads</b>	<b>LRT-Clark</b>	<b>Metrorail</b>
Daily Ridership	36,500	36,100	33,700	33,600	31,000
New transit riders	11,100	7,300	5,800	5,300	11,700
Change in travel time by auto	-8 minutes	-9 minutes	-6 minutes	-7 minutes	+2 minutes
Change in travel time by transit	-3 minutes	-5 minutes	-2 minutes	-4 minutes	+2 minutes
Non-work trips	12,200	12,000	11,200	11,200	10,300
Peak hour trips	5,100	5,100	4,700	4,700	4,300
Work trips	24,100	23,800	22,200	22,200	10,500
Transit mode share	5.8%	5.9%	5.6%	5.6%	5.4%
Construction cost (millions of \$s)	50.3	56.2	206.9	208.5	138.9
Annual operating & maintenance costs (millions of \$s)	9.3	9.4	11.4	11.5	4.2
Change in daily Metrorail ridership	-8,100	-11,100	-9,100	-11,600	6,800

## STUDY CONCLUSIONS

- 1) Bus Rapid Transit, Light Rail Transit, and Metrorail are all viable alternatives that effectively and positively respond to the goals established for this project.
  - All alternatives improve non-highway modes of travel.
  - All alternatives result in significant transit ridership.
  - All alternatives result in reduced travel times for all modes in the corridor (except Metrorail which results in slightly increased travel times due to the addition of new transit stations on an existing line).
  - All alternatives contribute to increased circulation and mode choice.
- 2) Projected transit ridership for the corridor provides ample justification to advance the project into the Federal Transit Administration project development process and New Starts Program.
- 3) The Bus Rapid Transit Alternative (Eads Street) produces the greatest transit ridership. Much of the difference between the projected BRT and LRT ridership is based on the differing headways used for the analysis. (The headways for BRT were reduced to 6 minutes when the model predicted ridership that meant that the capacity needs could not be met by the original 10-minute headways.)
- 4) The BRT and LRT alternatives provide better access to areas within the corridor; while, the Metrorail alternative provides better connectivity to the rest of the Metropolitan Washington DC area.
- 5) The capital costs of the BRT alternatives are significantly cheaper than the capital cost of either Metrorail or LRT. The BRT capital cost range from \$50 to \$60 million; the Metrorail stations capital cost are in the range of \$140 million; and the LRT capital costs are in the range of \$210 million. The lower cost of the capital outlay needed for BRT could speed up project construction and operation as compared to the LRT or Metrorail alternatives.
- 6) Although the difference between the overall cost of BRT and Metrorail diminish when the twenty-year present value cost is calculated, the cost of construction and operation of BRT is slightly less expensive than Metrorail. The twenty-year present value costs are as follows: \$160 million for BRT; \$190 million for Metrorail; and \$340 million for LRT.

- 7) All modes can currently handle the ridership forecasted for their vehicles. However, if ridership exceeds the projected 2025 levels, BRT may have difficulty meeting the additional demand since further reduction of headways could negatively affect both the BRT service and local traffic.
- 8) BRT appears to offer the most cost-effective means of serving the traveling public and creating the transit oriented development envisioned by Arlington County and the City of Alexandria. Operating on either Clark or Eads Street appears to achieve similar results, although the analysis indicates that the Eads alternative is slightly stronger. Both should be further examined in the environmental document.

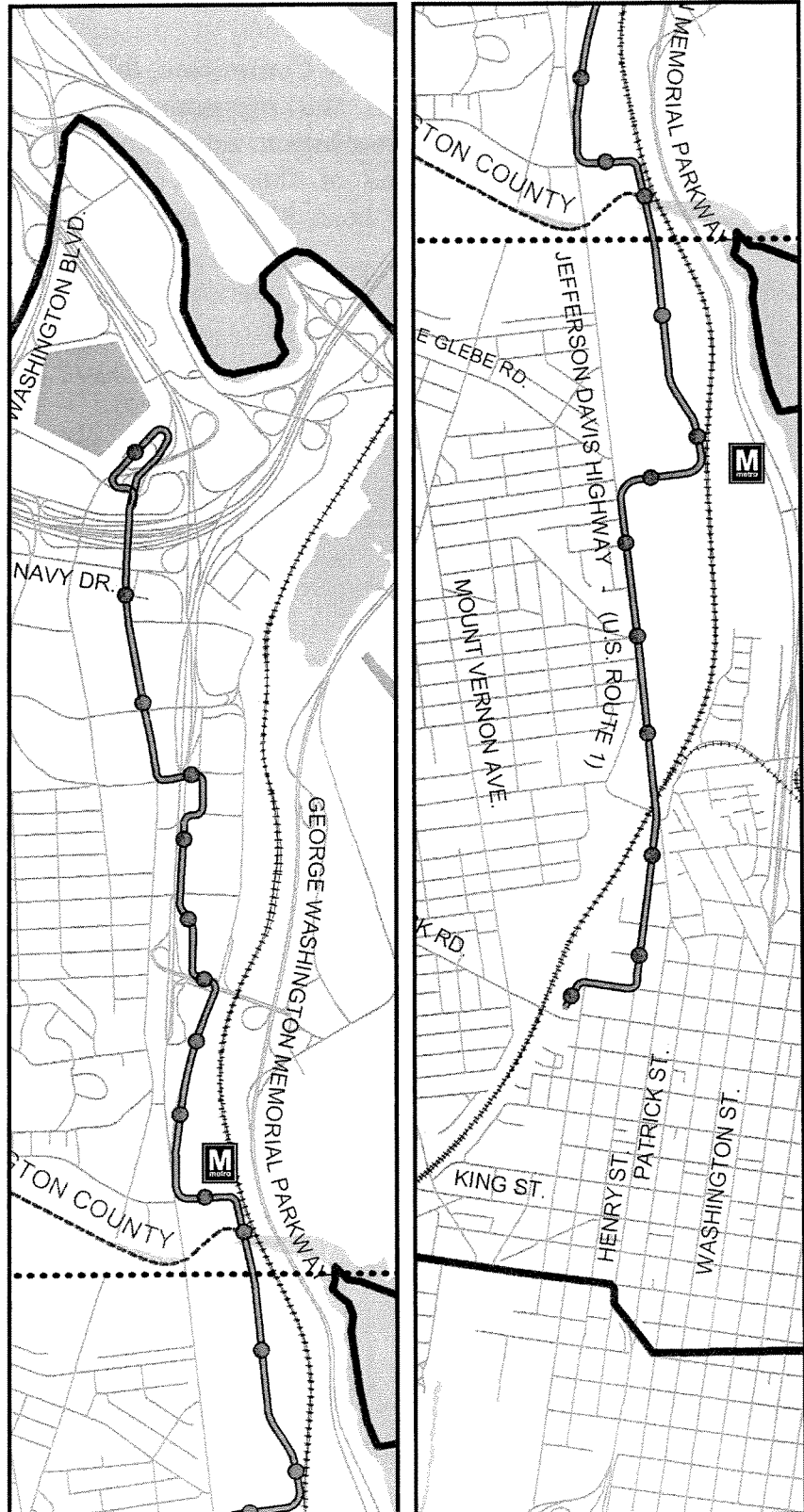
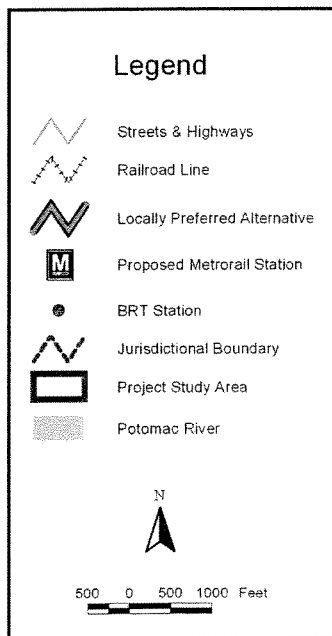
## RECOMMENDATIONS

Based upon the goals established in the Purpose and Need statement and the results of the evaluation criteria that articulate the specific project objectives, the study makes the following recommendations:

- 1) Bus Rapid Transit should be advanced as the locally preferred alternative (LPA) for transit in the Crystal City/Potomac Yard Corridor for purposes of the Federal Transit Administration's New Start Evaluation. (See Figure S-3).
- 2) Bus Rapid Transit, Light Rail Transit, and Metrorail are all viable options in regard to transit ridership for the Crystal City/Potomac Yard Corridor and therefore all three options should be carried forward into the environmental impact study.
- 3) The selection of the BRT alternative should not preclude future construction of one or more future Metrorail stations in the corridor. Future changes in the corridor beyond those currently envisioned for the year 2025, including changes in the Potomac Yard Retail Center, development of the North Tract, and proposed residential development in Crystal City may render transit capacity, beyond a BRT/LRT operation, necessary.
- 4) A number of issues that warrant further review have been documented, and these challenges should be addressed in the future environmental analysis.

# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig S-3  
LOCALLY PREFERRED  
ALTERNATIVE





## POLICY ADVISORY COMMITTEE RESOLUTION

The project's Policy Advisory Committee, following a review of the evaluation criteria and based upon the recommendation of the Technical Advisory Committee, passed a resolution endorsing BRT as the Locally Preferred Alternative for purposes of the FTA New Starts Evaluation while also recommending that the both Metrorail and LRT be further studied in the environmental analysis.

# 1. PROJECT OVERVIEW

This report presents the results of the Virginia Department of Rail and Public Transportation's (DRPT) study of transit options for the Route 1 corridor, between the Braddock Road and Pentagon Metrorail Stations. This area, known as the Crystal City/Potomac Yard (CCPY) corridor, lies within the City of Alexandria and Arlington County, as shown in Figure 1-1. Formerly a major Richmond, Fredericksburg, and Potomac (RF&P) rail yard, the jurisdictions identified this area for high and medium density mixed-use redevelopment. Both jurisdictions approved a development plan along with conditions to guide this redevelopment: Alexandria in 1999; Arlington in 2000. One guiding assumption in the master plan for the corridor was that adding significant highway capacity to this corridor would be infeasible; therefore, any new development must be transit-oriented. As private developers brought forth proposals, the City of Alexandria and Arlington County have tied approvals to the principle that the design of their development must be transit-supportive. Recognizing that transit is critical to implementing their master plans for the area, the City of Alexandria and Arlington County requested that DRPT initiate this study.

## 1.1 REPORT OVERVIEW

This study was conducted to meet the requirements of the Federal Transit Administration's (FTA) *New Starts* program, as DRPT and the local jurisdictions would like the option of seeking federal funding under this program. In evaluating whether to fund a transit program, FTA requires:

- Demonstration that the project has the support of the public and that consensus has been reached on a locally preferred alternative (LPA);
- Analysis of the project's ridership characteristics and feasibility;
- Estimates of the project's costs; and
- Evaluation of the project's potential environmental benefits and environmental challenges.

This report documents the process DRPT used to develop and evaluate alternatives and engage the public in the alternatives development and decision-making process for the CCPY corridor. The report is organized as follows:

Chapter 1: Project Overview – The chapter includes: an overview of the report; a description of how the study originated; a description of the study methodology; and overview of public outreach; and a description of the steps that will need to be taken subsequent to the conclusion of this study.

Chapter 2: Project Purpose and Need – The chapter includes a description of the need for transit in the corridor. The full Purpose and Need Statement developed for the study is provided.

Chapter 3: Study Area - The chapter includes: a detailed description of the project study area and existing transportation system; a detailed summary of the development planned for the area; and an overview of the environmental constraints of the project study area.

Chapter 4: Transit Technologies – The chapter describes the modal alternatives evaluated in this document.

Chapter 5: Development of Conceptual Alternatives - This chapter describes the process employed to create the initial alternatives for transit in the corridor.

Chapter 6: Tier 1—Alternatives Evaluation - This chapter describes the process used to formulate a first “tier” of alternatives; the analysis used to refine that extensive list of alternatives to a more concise choice; and the alternatives that were advanced to Tier 2.

Chapter 7: Tier 2—Alternatives Development - This chapter discusses the refinements to those alternatives.

Chapter 8: Tier 2—Evaluation – This chapter outlines the criteria used and discusses the evaluation of the Tier 2 alternatives.

Chapter 9: Conclusions and Recommendations - This chapter presents the findings of this study and the Study Team’s recommendation of a locally preferred alternative for which a New Starts Evaluation should be submitted.

Chapter 10: Issues for Future Consideration – Discusses issues that should be addressed in the environmental analysis.

Chapter 11: Development of an Investment Strategy for the Locally-Preferred Alternative - Summarizes the anticipated costs and revenues for the alternatives and suggests some alternative means of financing the project.

## 1.2 STUDY ORIGINS

The study area, shown in Figure 1-1, encompasses 8.9 square miles of land in southern Arlington County and eastern Alexandria: 4.9 square miles in Arlington and 4.0 square miles in Alexandria. The primary focus for any future transit service is the approximate one and one-half square miles of land adjacent to U.S. Route 1 and falling within the former RF&P rail yard.

The area slated for development was once a rail yard for several railways. The yard was opened in 1906 and remained in operation until 1992. The former railroad yard contains 368 acres. About 23 percent of the yard (87 acres) lies within Arlington County; the remaining 77 percent (281 acres) lies in the City of Alexandria. The City and the County are working together in the development of this land that is among the last large developable tracts in both jurisdictions. The proposed development would include a dense residential area interspersed with retail and office spaces. There are also provisions for some form of future transit.

Route 1, traveling through the center of the project study area, is a major commuter route between Fairfax County south of Alexandria, Alexandria, Arlington and Washington, DC. The George Washington Memorial Parkway (GWMP), which runs parallel to Route 1, is intended primarily as a scenic parkway, but carries substantial commuter traffic as well. The GWMP operates as a limited access highway through most of the study area and cannot offer the local service needed for the future development. Road widening, on either of the two roadways in the vicinity of Potomac Yard, is not under consideration by the local jurisdictions or the National Park Service.

Because of travel demand anticipated from the approved development in the corridor and the current popularity of Route 1 as a commuter route, the traffic demand on the study area's highway network is expected to increase beyond its capacity. This growth in travel demand, according to one Virginia Department of Transportation (VDOT) study, cannot be supported by road improvements. In fact, "most previously considered road improvements are either infeasible or fail to provide additional capacity where it is most needed for the area. Therefore, mass transit will be required in the corridor to reduce vehicle trips."<sup>1</sup>

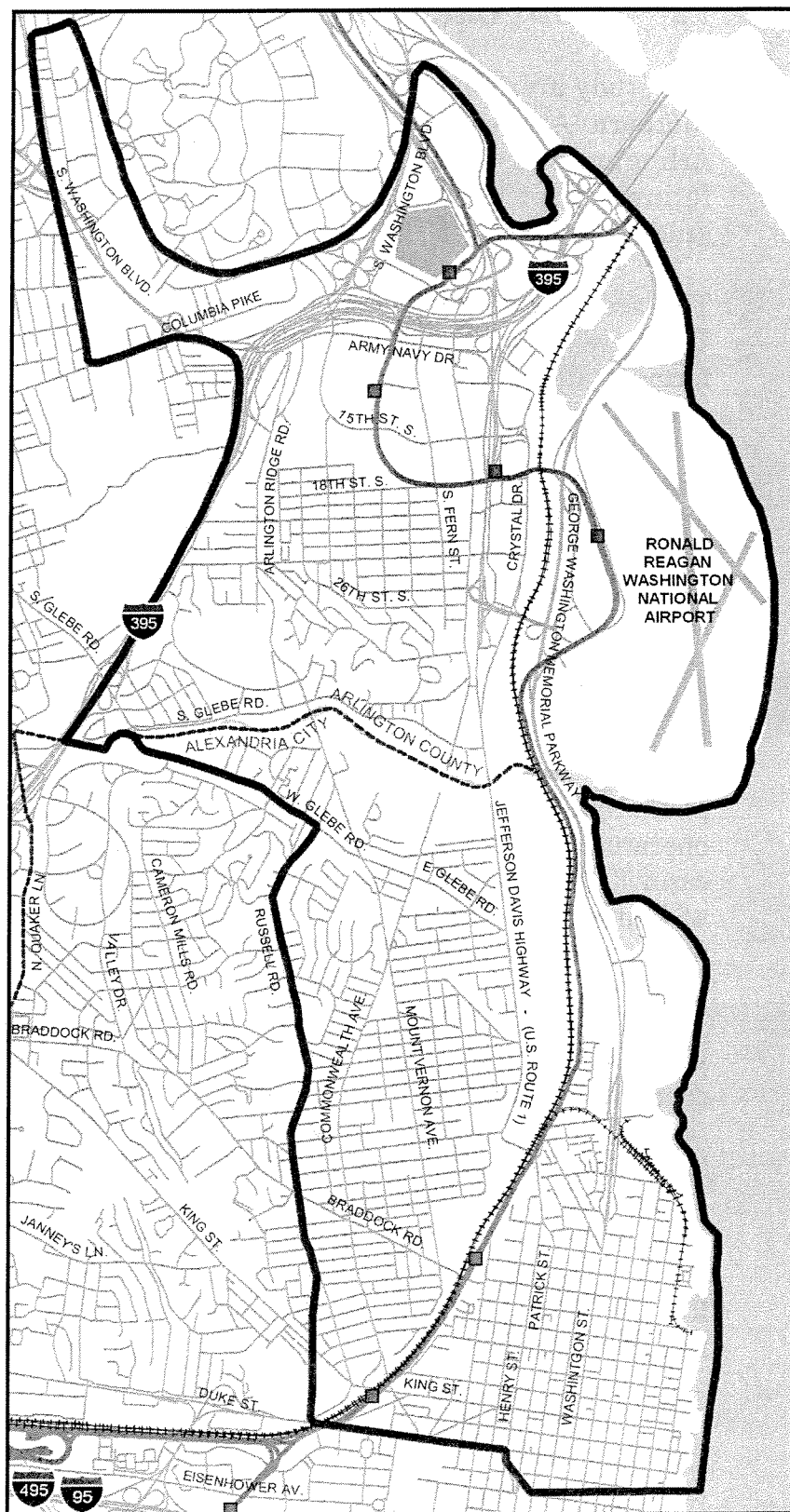
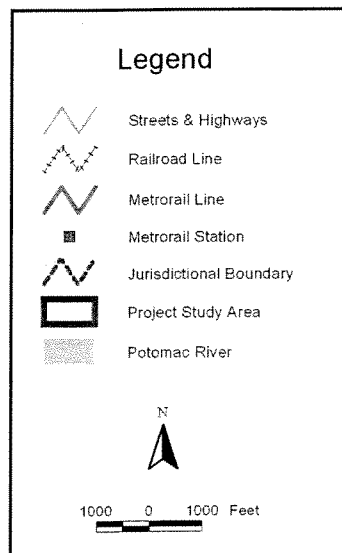
For decades, transit has been recommended as part of any development for Potomac Yard. The culmination of those recommendations is embodied in the development approvals in both Arlington and Alexandria. While the specific

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<sup>1</sup> Virginia Department of Transportation. *Crystal City/Potomac Yard Area Transportation Study, SJR 406 [HJR 567] Report*, October 1999.

# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig 1-1  
STUDY AREA



nature of the transit has not been fully articulated the intent to have a strong transit presence has been clearly stated.

A previous developer of this land, Commonwealth Atlantic Properties, included a Metrorail station as part of their development plan in the Alexandria portion of the Yard. However, subsequent changes to the plan reduced the density for the property below the threshold originally envisioned, and the construction of the station was no longer viable for the developer. Although the current developer's plan for the Yard does not include a Metrorail station, there is an agreement with the City, that the space for construction of a future station will be retained on the property.

Further indicating that the long term vision for corridor includes the construction of major transit infrastructure is the fact that the Northern Virginia Transportation Coordinating Council's *2020 Transportation Plan*, the Metropolitan Washington Area Transit Authority's (WMATA) *Transit Service Expansion Plan*, and Metropolitan Washington Council of Governments' (MWCOC) 2000 Financially Constrained Long-Range Plan (CLRP) include the construction of a Potomac Yard Metrorail/Virginia Railway Express (VRE) station by 2005<sup>2,3,4</sup>. In addition, The *Northern Virginia 2020 Plan* also calls for a light rail or bus rapid transit line in the corridor along U.S. Route 1. Clearly an expansion of the transportation system supporting the Potomac Yard areas has been under consideration for many years. It is also clear that transit plays a major role in the vision for the expansion of the corridor and supports the demands of the future Potomac Yard.

### 1.3 STUDY METHODOLOGY

Typically, transit projects in the United States are put in place through the cooperation of the local jurisdictions through which they pass. The state or states in which those jurisdictions are located also contribute with financial and technical resources, as does the federal government.

While each level of government imposes its own processes and regulations on transit planning and implementation, it is the federal government's rules that are the most important in defining the flow of a project. Because the federal government, through the Federal Transit Administration, typically

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<sup>2</sup> Northern Virginia Transportation Coordinating Council, *Northern Virginia 2020 Transportation Plan for Public Review and Comment*, June, 1999.

<sup>3</sup> National Capital Region Transportation Planning Board, *Financially Constrained Long Range Plan 2000*, seen on <http://www.mwcog.org/trans/Va-T-11.pdf>

<sup>4</sup> Washington Metropolitan Area Transit Authority, *Transit Service Expansion Plan*, April, 1999.

pays fifty percent or more of the total project construction cost, careful observance of FTA's procedures is essential to securing those funds.

Planning for transit in the Crystal City/Potomac Yard Corridor has followed a project development process consistent with practices in other locales and FTA. In previous years, a feasibility study of transit for the corridor was completed to establish the overall value and to help define the project. This study, an alternatives analysis, is the next step in the FTA process.

Figure 1-2 shows the steps typically followed as a transit project moves from initial concept to actual implementation following the FTA guidelines for New Starts Projects. The Crystal City/Potomac Yard Corridor Transit Alternatives Analysis commenced mid-year of 2001.

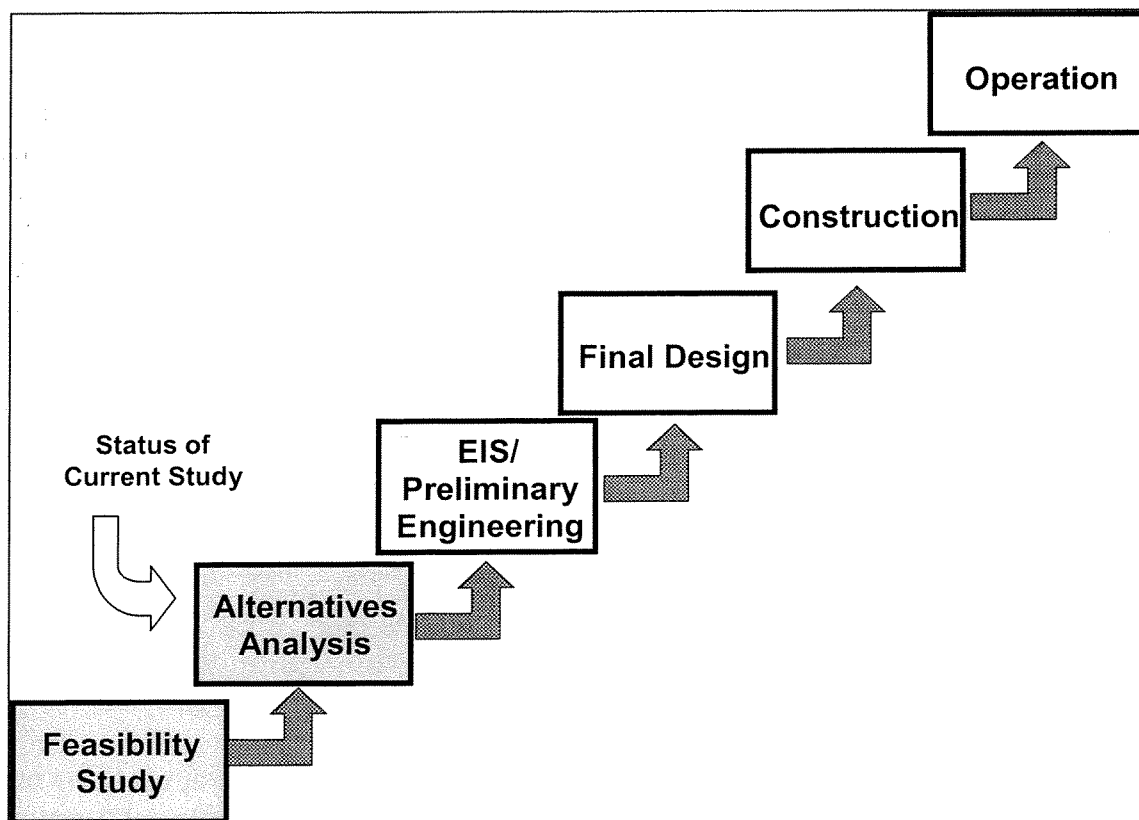


Figure 1-2  
Major Steps in Transit Development

The scope of this study was formulated around a six-step process (Figure 1-3). The general approach for this study has been to:

- Develop project goals and establish existing and baseline conditions.
- Develop a broad number of alternative transit services to serve the corridor.
- Evaluate each of those alternatives so as to identify the strongest alternatives and the strongest aspects of those alternatives.
- Reduce the number of alternatives.
- Study the reduced list of alternatives in greater detail.
- Select the strongest alternative, or combination of alternatives and elements of alternatives, that best meets the goals of the project.

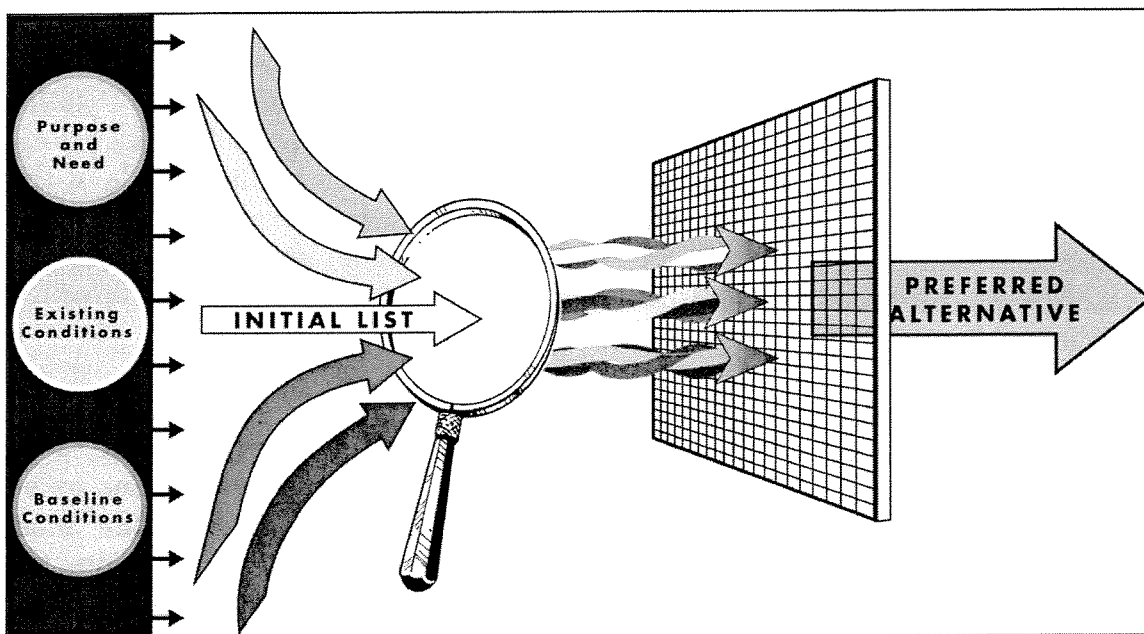


Figure 1-3  
Transit Alternatives Development Process

The initial tasks included developing an understanding of current and future conditions forecasted for the corridor. It also included developing and understanding of the goals for transit in the study area.

Purpose and Need Statement - The Purpose and Need Statement is a concise statement of the goals and objectives intended for transit in the Crystal City/Potomac Yard Corridor. Formulated in cooperation with representatives from the jurisdictions and others, including the general public, this statement defines the criteria against which alternatives are evaluated. The Purpose



and Need statement also defines the overall definition of success for a transit improvement in the study area.

Existing Conditions Assessment - The existing conditions assessment was another important step in understanding the area to be served. Today's conditions represent a common reference point for future study. It is observable and something with which the general public, the ultimate beneficiaries of transit in the corridor, can understand.

Baseline Conditions - The baseline conditions, unlike the existing conditions, are the conditions anticipated in the future in the absence of a new major transit investment. At one time, the baseline condition was referred to as the "no-build" condition. It included the forecast changes in land use and transportation throughout the region, exclusive of the specific improvements under study. In recent years, FTA has encouraged the examination of a more ambitious future condition than "no-build." Recognizing that in the absence of the transit project under study, localities would undertake some reasonable low-cost measures that attempts to meet the transit needs of the corridor, FTA prefers that comparisons of transit improvements be made against something more than a "no-build" option. Therefore the study team developed an alternative baseline "lite" for study analysis. The baseline condition is discussed further in Appendix B.

Transit Technologies - In project scoping, various alternatives were considered. However, only three alternative transit technologies were proposed for further investigation in this study. While many options exist, heavy rail, light rail, and bus rapid transit were considered the most appropriate for the corridor given the time frame for implementation, the nature of corridor, and the types of transit, both in place and under consideration, within the Metropolitan Washington region. These three technologies are discussed in Chapter 4.

Alternatives Development - Armed with a purpose and need statement, knowledge of existing conditions, and basis of comparison in the form of the baseline condition, the Study Team began to develop alternatives. In the current study, the Study Team examined alternative means of serving the corridor between the Braddock Road Metrorail Station and the Pentagon Metrorail Station by using alternative routings of bus rapid transit (BRT), light rail transit (LRT), and alternative placement of new Metrorail stations. Several concepts, developed in prior studies, were included for consideration, along with new concepts developed uniquely for this study.

Each of these alternatives was examined and compared. The strengths and weaknesses of each were identified in light of the project's overall goals. The

best portion of all alternatives were noted and repackaged to form a smaller list of new alternatives. The reduced number of alternatives were then developed in greater detail and again scrutinized and evaluated.

The Study Team, including members of Policy and Technical Advisory Committees, with advice and guidance from the general public, then identified the alternative that appears to best meet the goals initially declared for this project. This alternative, termed the locally preferred alternative (LPA), will be submitted to the FTA in a request for funding in order to advance the project toward construction.

## 1.4 PUBLIC PARTICIPATION

Public involvement was integral to this study with numerous opportunities for interaction between the Study Team and the public throughout the course of the work. Consultation with elected officials and public agency staff was similarly central to this work. The following sections describe the various means by which the public was brought into the study process and had opportunity to shape the final recommendations coming from this project.

### 1.4.a. Technical and Policy Advisory Committees

Two committees, the Technical Advisory Committee (TAC) and the Policy Advisory Committee (PAC) were created to work closely with the study team. These committees met on a regular basis during the different phases of the project in order to provide important input and agency coordination.

Technical Advisory Committee - The Technical Advisory Committee includes transportation and planning staff from the participating jurisdictions, the state and regional agencies responsible for transportation in the study area, the Federal Transit Administration, the Pentagon/Department of Defense, and the developers of Crystal City and Potomac Yards. The TAC served as a source of information for this study and also as a reviewer. Basic land use and transportation data were made available to the study team from the TAC members. Each aspect of the study was presented to the TAC for their consideration and comment. Elaboration of analysis and additional studies were performed on the basis of their advice. Table 1-1 identifies the members of the TAC.

**Table 1-1**  
**Technical Advisory Committee**

MEMBER	AGENCY REPRESENTED
Gabriela Acurio <sup>+</sup> Leon Vignes	Department of Planning, Arlington County
Deborah Burns	FTA Washington DC Office
Al Cox	Department of Planning and Zoning, City of Alexandria
Christopher Detmer	VDOT, Central Office
Kathleen Donodeo <sup>+</sup> Gregory Walker	Washington Metropolitan Area Transit Authority
Mike Hackett	Metropolitan Washington Airports Authority
James Hamre	Department of Public Works, Arlington County
Richard Hartman	Department of Public Works, Arlington County
Susan Hinton	NCR National Park Service
Kimberely Johnson	Development Division, City of Alexandria
Patricia Kampf	Federal Transit Administration
Betsy Massie <sup>+</sup> Tom Culpepper	City of Alexandria
Sandy Modell	Alexandria Transit Company
Valerie Pardo	VDOT Northern Virginia
Frank Poli	Charles E. Smith, Co.
Sharon Pugh	Federal Transit Administration
Jennifer Straub <sup>+</sup> Alfred Titus-Gover	Northern Virginia Transportation Commission
Tom Tucker <sup>+</sup> Position Vacant	Manager Support, Department of Defense

<sup>+</sup> Individual replaced by name immediately below

Policy Advisory Committee - The Policy Advisory Committee is comprised of elected officials from Alexandria and Arlington at both the local and state levels. The PAC reviewed each aspect of the project and gave policy guidance on the nature and direction of the study. The PAC also closely scrutinized material prior to presenting it to the public. The members of the PAC are identified in Table 1-2.

**Table 1-2**  
**Policy Advisory Committee**

MEMBER	OFFICE
Leo Bevon + Karen Rae	Director, Dept. of Rail and Public Transportation
Honorable Kerry Donley**	Mayor, City of Alexandria
Honorable Christopher Zimmerman**	Chair, Arlington County Board
Honorable Jay Fisette	Member, Arlington County Board
Honorable David Speck	Councilman, City of Alexandria
Honorable Patsy Ticer	Senate of Virginia
Honorable Mary Margaret Whipple	Senate of Virginia
Honorable Marion Van Landingham	Virginia House of Delegates
Honorable Karen Darner	Virginia House of Delegates
Honorable Robert Brink	Virginia House of Delegates
Richard White*	Washington Metropolitan Area Transit Authority

+ Individual replaced by name immediately below

\* Mr. Richard Stevens sat in for Mr. White

\*\*Policy Advisory Committee Chairs

#### 1.4.b. General Public

Public participation was encouraged throughout this study. The team employed many means to notify and involve the public. These strategies included:

- Mailing database
- Toll-free telephone hotline {888-550-CCPY (2279)}
- Study website ([www.route1transit.com](http://www.route1transit.com))
- Electronic mail addresses of project managers
- Briefings to local elected officials
- Individual meetings of community groups
- Meetings with local governing boards and agencies
- Two general public information meetings near the beginning of the study
- Two general public information meetings near the end of the study
- Educational materials
- Comment summary database

Some of these strategies are described in detail:

Internet Site - The Virginia Department of Rail and Public Transportation (DRPT) created [www.route1transit.com](http://www.route1transit.com) as the project website. The site includes information on meetings, description of the project, maps, downloadable information, and contact information.

Telephone Hotline - DRPT also established a toll-free hotline {1-888-550-CCPY(2279)} for inquiries. An effort was made to choose a number that the public could remember. The hotline number was placed in every presentation, on the website, and on mailings. Members of the public could contact project staff with comments and questions.

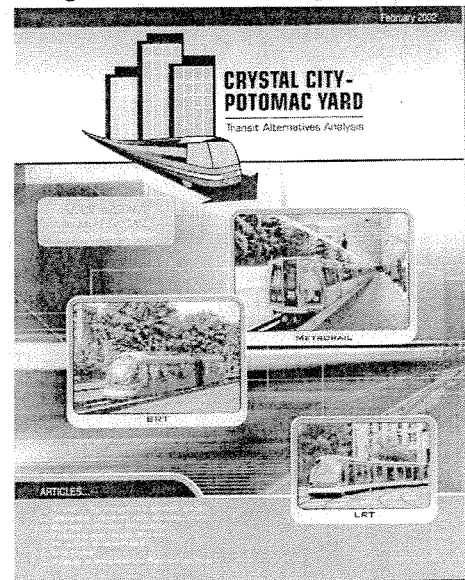
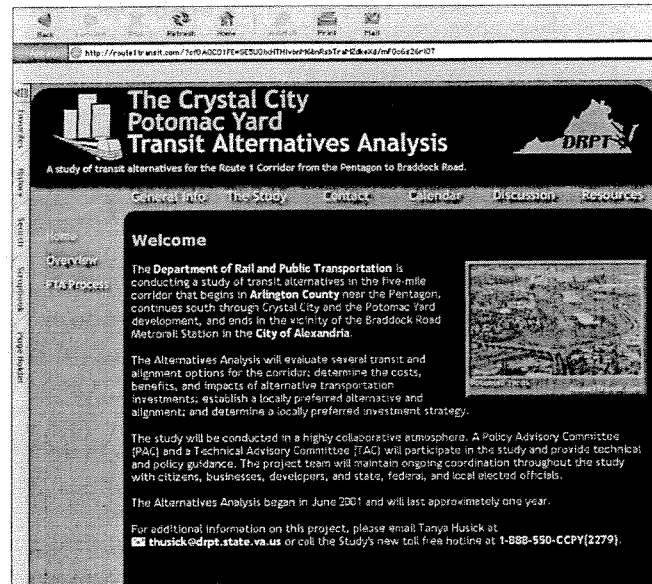
#### Educational Materials/Newsletter -

A newsletter was published and distributed to those who signed up either on-line, over the telephone, or at community meetings. Study materials were distributed at the community meetings as well as the posted on the official website.

General Public Meetings - Public meetings were given special attention, due to a strong response from community members. The study team conducted several of these meetings during the course of the study. At the meetings, the technical findings and recommendations were presented to the public for their review and comment.

Community Group Meetings - Members of business, residential and local transportation communities expressed interest in adding their input. The study team responded by having many community group meetings to accommodate the demand. Listed are the groups with whom the study team met:

- Alexandria Chamber of Commerce Transportation Task Force
- North Tract Citizens Advisory Group
- Northern Virginia Transportation Coordinating Council
- Northeast Citizens Association
- Aurora Highlands Civic Association
- Arlington Transportation Commission



- Mount Jefferson Civic Association
- Del Ray Citizens Association
- Lynhaven Civic Association
- Colecroft Owners Association
- Arlington Ridge Civic Association

## 1.5 PROJECT DEVELOPMENT

The identification of the LPA is only the next step in a lengthy process. Subsequent to this study, the project will undergo an examination of environmental impacts as summarized in an environmental impact statement (EIS). The environmental study will follow the procedures outlined in the *National Environmental Policy Act* (NEPA) and associated federal regulations and guidelines, as well as applicable state and local guidelines. All reasonable alternatives, including the LPA from the alternatives analysis, will be scrutinized under NEPA. All alternatives will be compared against a “no build” condition. The alternative, no build or build, that best achieves the purpose and need statement would be recommended for implementation.

Upon a positive review by the various cooperating federal, state, and local agencies, a record of decision (ROD) would be signed. The ROD identifies the alternative recommended for implementation in the environmental document, along with the mitigation measures and other conditions required to minimize harm to the environment. At this time, FTA would also have an opportunity to evaluate the effectiveness of the proposed project. If viewed favorably, it could be funded for preliminary design, final design, and ultimately construction.

Actual funding at these more advanced levels become increasingly dependent upon the project’s proponents demonstrating the project’s effectiveness, feasibility, and public’s support. The New Starts Evaluation Process, an FTA formulated process, compares the project with other projects competing for federal funding. Using specific common evaluation criteria, the FTA rates each project and authorizes funding to those that offer the greatest promise.

The study and funding process can be quite long and in many respects repetitive. Projects can easily take ten years from initial concept to construction. On the other hand, each subsequent analysis goes into greater detail and is built upon a better base of knowledge, so that the end product is truly the transit service that will best meet the needs of the community that it serves to the broadest level of satisfaction.

The subsequent chapters of this report describe in greater detail, the study steps, the results, and the recommendations for transit in the Crystal City/Potomac Yard Corridor.

## 2. PROJECT PURPOSE AND NEED

The purpose of the *Crystal City/Potomac Yard Corridor Transit Alternatives Analysis* is to develop, evaluate, and recommend feasible transportation improvements in the corridor. These improvements will address the transportation needs of the developing corridor and minimize adverse impacts to its congested roadways and neighboring communities.

### 2.1 PROJECT PURPOSE

Given the anticipated travel demand of the corridor and the limited ability to add significant vehicular capacity to existing roadways in the area, the study focuses on an evaluation of transit technologies, alignments and alternatives. The outcome of the study is a locally preferred alternative suitable for further consideration and possible inclusion in the Constrained Long Range Plan (CLRP).

An initial step in the formulation of enhanced transit in the Crystal City /Potomac Yard corridor was the development of a “Purpose and Need Statement.” The purpose and need statement gives direction to the project and context to the problem under investigation for all interested parties. The purpose and need statement was developed in cooperation with the Technical and Policy Advisory Committees and the general public. It describes the background of the project and concludes with the specific goals for which transit is intended to respond.

### 2.2 PURPOSE AND NEED STATEMENT

The *Crystal City/Potomac Yard Corridor Transit Alternatives Analysis* is investigating transit options to serve a five-mile corridor in the area west of the Potomac River that runs from the Pentagon in Arlington to the Braddock Road Metrorail Station in Alexandria, Virginia. The need for this study stems from increasing density and development in the corridor, increasing automobile congestion, and the recent approvals of new development projects on the Potomac Yard site located within the corridor. These factors present a unique opportunity to facilitate transit-oriented development through the construction of an appropriate complementary transit system.

Development agreements approved by the City of Alexandria and Arlington County for the Potomac Yard site and within Crystal City identify the need to work collaboratively with transportation providers serving the area to create an effective and efficient transportation system. Given the density of the approved development as shown on Table 2-1 below, the proposed pedestrian-oriented design of the development and the degree of vehicular congestion



already present in the corridor, a transportation option focused on transit appears to be a logical solution.

**Table 2-1**  
**Approved Development for Potomac Yard & Potomac Greens**

<b>Jurisdiction</b>	<b>Office (Mil. Sq. Ft.)</b>	<b>Hotel (Units)</b>	<b>Retail (Mil. Sq. Ft.)</b>	<b>Residential (Units)</b>
<b>Alexandria</b>	1.90	625	0.735	1,927
<b>Arlington</b>	2.88	625	0.060	1,000 <sup>1</sup>
<b>Potomac Yard &amp; Greens</b>	4.78	1250	0.795	2,927
<b>Crystal City</b>	0.44	1,227	0.172	379
<b>TOTAL</b>	5.22	2,477	0.232	3,306

Earlier studies by the Virginia Department of Transportation (VDOT) investigated both highway and transit improvement options, and determined that highway improvements alone could not effectively meet mobility needs in the corridor.<sup>2</sup> VDOT concluded that the only way to avoid a failure of the existing road system was with a high level of improved transit service.

The Washington Metropolitan Area Transit Authority (WMATA) also examined the potential to improve transit service in the corridor. The WMATA study investigated several alternatives for light rail transit (LRT) between the Pentagon and Braddock Road Metrorail Stations.<sup>3</sup> The WMATA study was preliminary in nature and did not investigate the feasibility and impacts of these alternatives in great detail.

### 2.2.a. Purpose

The purpose of the *Crystal City/Potomac Yard Corridor Transit Alternatives Analysis* is to develop, evaluate, and recommend feasible transportation improvements and financing strategies. Those improvements will address the transportation needs of this developing corridor and minimize adverse impacts to its congested roadways and neighboring communities. Given the anticipated travel demand of the corridor and the limited ability to add significant vehicular capacity to existing roadways in the area, the study focuses on an evaluation of transit technologies, alignments and alternatives. Investigations address:

- Improvements necessary to serve the travel demand generated by the corridor,

<sup>1</sup> Actual approved development is for 1 million square feet of residential which could result in a range of 800 to 1,200 units depending on size of the units.

<sup>2</sup> *Crystal City/Potomac Yard Area Transportation Study*, October 1999

<sup>3</sup> Transit Service Expansion Plan, March 2001.

- The need and opportunities for improving connections from the corridor to surrounding areas,
- Opportunities to take maximum advantage of high capacity transit investments already present in the corridor, such as Metrorail,
- Opportunities to improve overall mobility and connectivity within the corridor.

The outcome of the study is a locally preferred alternative suitable for further consideration and possible inclusion in the Constrained Long Range Plan. Virginia's Department of Rail and Public Transportation (DRPT) is the sponsoring agency for this study.

### **2.2.b. Significance Of The Crystal City/Potomac Yard Corridor**

Potomac Yard is a 368-acre tract bounded on the north by South 26<sup>th</sup> Street; on the east by George Washington Memorial Parkway (GWMP), Ronald Reagan Washington National Airport (National Airport) and the Potomac River; on the south by Braddock Road and on the west by Jefferson Davis Highway (Route 1). Of the tract's 368 total acres, 300 acres are undeveloped and 68 acres are developed as a retail center. The undeveloped portions of the Potomac Yard site represent the only large vacant tract available for development in proximity to National Airport, the Pentagon, Pentagon City, Crystal City, and Old Town Alexandria. The northern 87 undeveloped acres of the site are located within Arlington County, Virginia. The southern 281 undeveloped acres of the site are located within the City of Alexandria, Virginia.

The site is located in one of the primary north/south commuter corridors between downtown Washington D.C., the Pentagon, Alexandria, and the Virginia suburbs. Vehicular access to the site is limited to the western side from Route 1. Access to the Metrorail lines could be possible with the addition of a station or stations along the eastern edge of the site.

The Potomac Yard site has had a long history of use for rail transportation beginning around the turn of the last century and continuing through today. The site was a major rail yard from the early 1900's through 1992. In 1992 the site ceased operations as a rail yard and in 1993 was conveyed to private interests for the purpose of development. Active rail service still exists along the eastern edge of the site.

High-density office, hotel and residential development areas lie to the north of Crystal City and Pentagon City. More than 35 million square feet of uses exist in these two areas and it is estimated that the areas have a daytime population of upwards of 60,000 people. Improving non-vehicular

connections between Crystal City, Pentagon City and approved development on the Potomac Yard site will be an important part of this study effort.

East of Crystal City lies Ronald Reagan Washington National Airport. The airport is situated on 860 acres of land extending into the Potomac River. More than 15.9 million passengers use the airport annually—an average of 42,000 per day. Approximately 50,000 vehicles travel the airport's roads daily. Passengers access the airport by Metrorail, bus, shuttle, and taxi as well as by private automobile. The airport also employs more than 10,200 people.

To the south of Potomac Yard is the Braddock Road Metrorail Station. The station lies on the west end of Old Town, in an established, mixed-use neighborhood. Connections between Potomac Yard and this area would benefit the station area and improve connectivity between Potomac Yard and the metropolitan region.

Finally, lying north of Crystal City is the Pentagon, with a projected employment base of more than 23,000 in 2012. It the largest inter-modal center in Virginia. Linking transit in the corridor to this hub would be beneficial to residents and employees both inside and outside the corridor.

### 2.2.c. Project Goals

The *Potomac Yard/Crystal City Corridor Transit Alternatives Analysis* identifies the most feasible transit alignment and technology solution(s) that can be implemented in the corridor. A primary component of study work is to assess how well transit strategies in the corridor meet the following broadly defined goals.

1. Accommodate increasing mobility demands by increasing the capacity of non-highway modes of travel.
2. Minimize adverse impacts of the locally preferred alternative on existing commuter routes in the corridor.
3. Increase the utility of transit and develop transit service and options that support transit as a preferred mode choice for a wide variety of trips beyond morning and evening commuting trips, thereby enabling and promoting a transit-oriented lifestyle.
4. Provide a high level of circulation and mode choice (transit, walking, biking, and auto) within Potomac Yard and between Potomac Yard and surrounding areas.
5. Optimize use of state and local financial resources.

6. Increase the use of the region's existing rail transit system.

Each alternative is tested against specific evaluation criteria designed to measure both qualitative and quantitative achievement of the preceding specific goals and objectives. The outcome is a locally preferred alternative that best fulfills the purpose and need of the project.



### 3. STUDY AREA

The focus of this study is the existing and planned development within Potomac Yard and Crystal City. Recognizing the relationship between the primarily residential areas immediately to the west of Route 1 and the commercial areas including the Mount Vernon Avenue corridor and Pentagon City, a study area was established that includes much of Old Town Alexandria and the areas within the City as far west as Russell Road. In the northern portion, the study area includes Aurora Highlands, the Arlington Ridge Area, and the areas immediately bordering Washington Boulevard on the periphery of Fort Meyers. In all, the study area encompasses approximately 8.9 square miles of which the areas surrounding Route 1 represent the greatest intensity of development. Most of the remaining portions of the area are generally comprised of low-density residential development and community retail. Figure 3-1 shows the study area boundaries.

#### 3.1 DESCRIPTION OF STUDY AREA

The core of the study area is the land immediately adjacent to U.S. Route 1. This area includes the Braddock Road Metrorail Station area, Potomac Yard, Crystal City, parts of Pentagon City, the Arlington North Tract, and the Pentagon Building and Metrorail station.

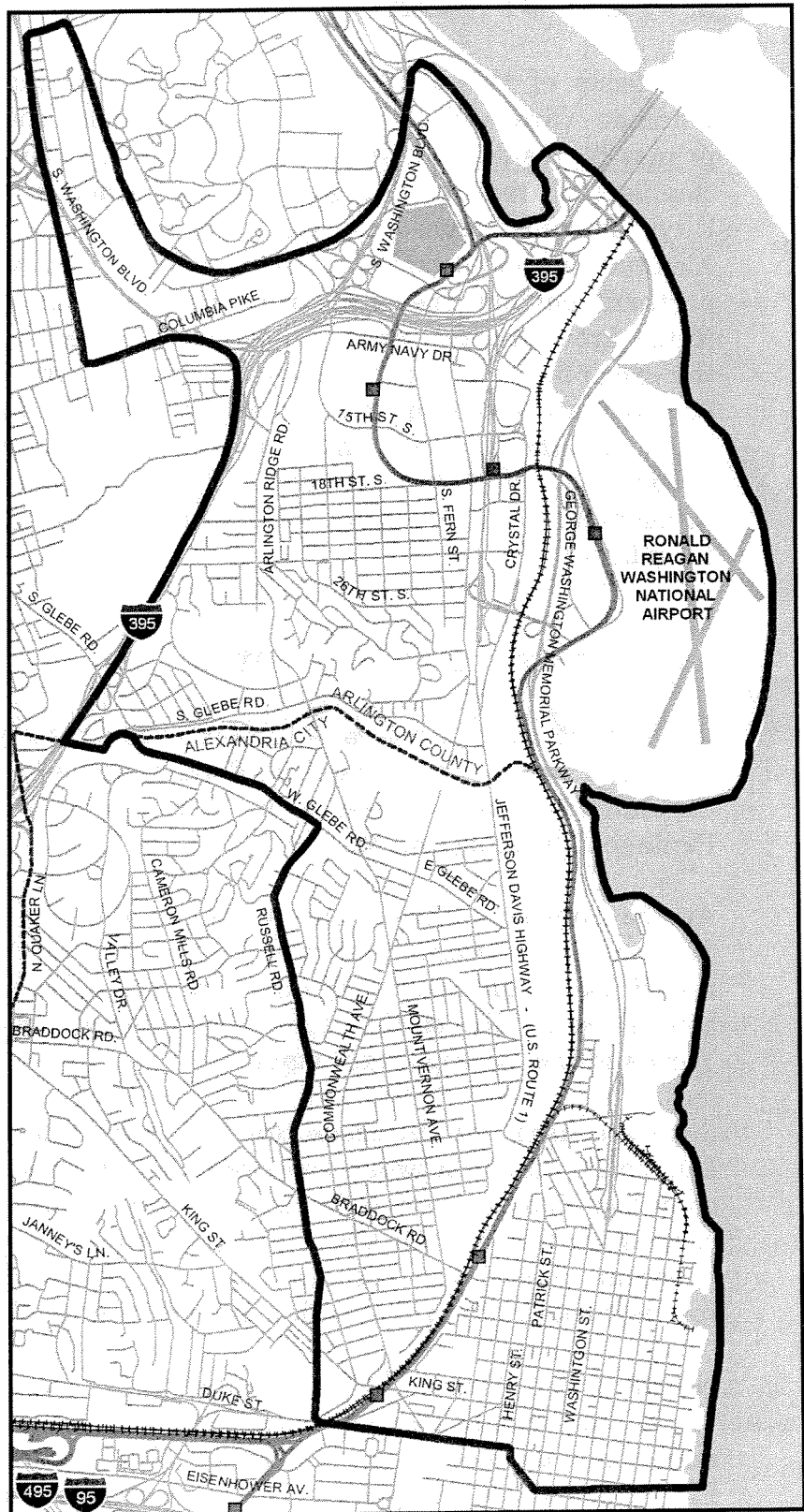
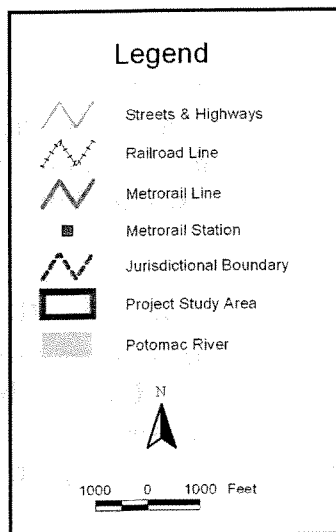
At the southern end of the study area is the Braddock Road Metrorail Station. The station lies on the western end of Old Town in an established, mixed-use neighborhood. Connections between Potomac Yard and this area would benefit the station area and improve connectivity between Potomac Yard and the metropolitan region.

Separate from the Braddock Road Metrorail Station area is Potomac Yard. Currently, traffic between the Braddock Road area and Potomac Yard must cross the Monroe Avenue Bridge, an oddly angled section of U.S. Route 1 that carries traffic over the CSXT railroad tracks. The City, in cooperation with Crescent Resources, the developer of Potomac Yard, is contemplating reconstructing the bridge with a more direct, north south orientation.

North of the Monroe Avenue Bridge is the Alexandria portion of Potomac Yard. This area is mostly vacant but development plans call for substantial residential development with some office and retail space. Table 3-1 with Figure 3-2 show the proposed plan for the Potomac Yard development. The northern section of Potomac Yard, within Alexandria, is the Potomac Yard

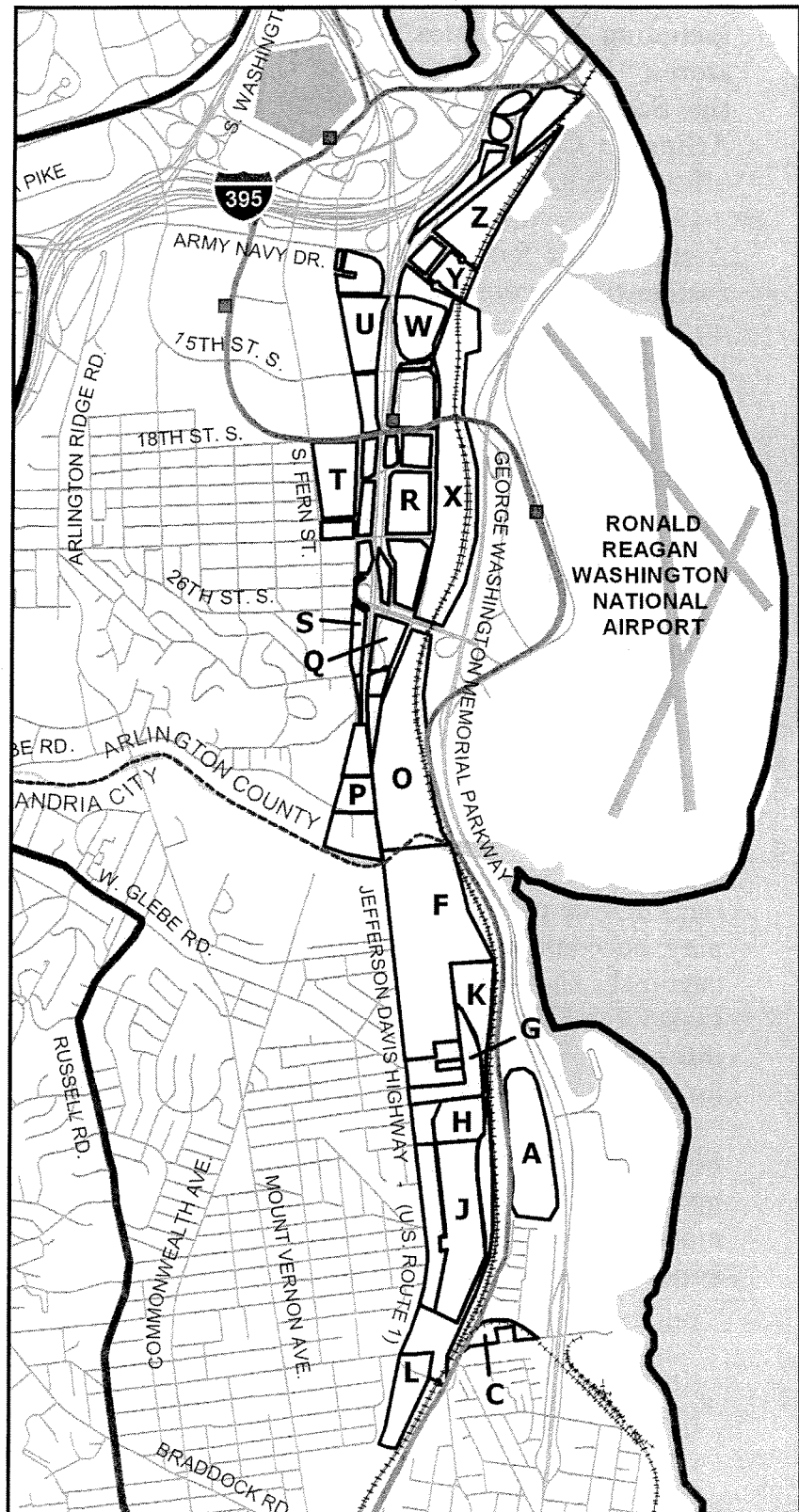
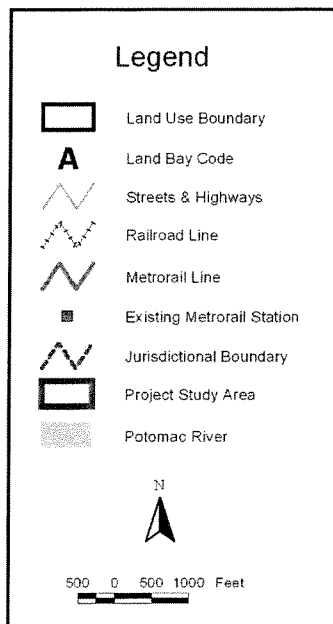
# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig 3-1  
STUDY AREA



# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig 3-2  
CRYSTAL CITY &  
POTOMAC YARD PROPOSED  
DEVELOPMENT PLANS





Retail Center. This area includes about 600,000 square feet of retail space including a multiplex movie theater, “big box” retail, and smaller retail stores. Immediately north of the retail center and across Four Mile Run is the South Tract. Currently an undeveloped area, the South Tract is the Arlington County portion of Potomac Yard. The tract will contain primarily office with some retail development similar to Crystal City.

A significant feature north of the site is the high-density office, hotel, and residential development areas of Crystal City and Pentagon City. More than 35 million square feet of development currently exist in these two areas and it is estimated that the areas have a daytime population of upwards of 60,000 people. Improving non-vehicular connections between Crystal City, Pentagon City and the approved development on the Potomac Yard site will be an important part of this study effort.

Ronald Reagan Washington National Airport lies east of Crystal City. The airport is situated on 860 acres of land extending into the Potomac River. More than 12.9 million passengers use the airport in 2002—an average of 34,000 per day. Approximately 50,000 vehicles travel the airport’s roads daily. Passengers access the airport by Metrorail, bus, shuttle, taxi, and private automobile. The airport also employs more than 10,200 people.

Lying north of Crystal City in Arlington County is the Potomac Yard North Tract. This area was once the home of a hotel complex, but now it is completely leveled. It is slated for future recreational use, primarily rectangular playing fields. A major recreation center and some office space may be constructed on the southern end of the area. The North Tract is currently the subject of a County study led by County staff and a citizens’ task force. The CCPY Alternatives Analysis has assumed a modest level of intensity of development on the site in the future, recognizing that the task force may ultimately recommend different development.

Finally, the Pentagon, with a projected employment base of more than 23,000 by 2012, sits on the northern end of the study corridor. It the largest inter-modal center in Virginia. Linking transit in the corridor to this hub would be beneficial to residents and employees both inside and beyond the corridor.

**Table 3-1**  
**Approved Potomac Yard Development Plan**

<b>Land Bay</b>	<b>Land Use</b>	<b>Approximate Acreage</b>
A	Townhouse	27.0
C	Office, Retail	4.3
F	Office, Retail	68.3
G	Apartment (large building)	8.6
	Office or Retail	6.0
	Hotel	1.4
H	Apartment (townhouse, stacked town house)	5.3
	Apartment (mixed-use)	2.7
	Office (mixed-use)	2.7
J	Apartment small	14.3
	Townhouse	15.7
L	Apartment small	6.0
	Office	6.0
O	Hotel	32.8
	Office	
	Retail	
	Apartment (1/3 medium-density residential)	16.4
P	Service Industry	10.2
	Government & Commercial Facility	6.4
	Service Industry	5.1
Q	50% high-density residential, 50% high density office, apartment, or hotel	2.0
	1/3 high-density residential/ 2/3 high-density office, apartment, or hotel	6.5
	Medium density hotel, office, or apartment	2.7
R	50% high-density residential, 50% high density office, apartment, or hotel	29.4
S	Service Industry	0.8
	High-density residential	11.5
	Public	0.5
T	Service Commercial	2.6
	Medium-density residential	13.9
U	High-density residential	25.5
W	50% high-density residential, 50% high density office, apartment, or hotel	22.8
	Low-density office, apartment, or hotel	5.2
	High-density office, apartment, or hotel	0.9
X	1/3 medium-density residential/ 1/3 low-density office, apartment, or hotel	53.4
Y	Low-density office, apartment, or hotel	14.0
Z	Public	20.5
	30% medium-density residential/70% low-density office, apartment, or hotel	9.5
	Public	10.2
	Service Industry	1.7

### 3.1.a. Existing Road Network

U.S. Route 1 (Jefferson Davis Highway or North Henry Street) is the major north-south connector in the study area. Mount Vernon Avenue is another such connector but with substantially less volume and capacity. East-west connectors are few. Currently, South Glebe Road in Arlington and East Glebe Road in Alexandria are the main thoroughfares linking Jefferson Davis Highway and Interstate 395 and other points to the west.

### 3.1.b. Existing Rail and Transit Network

The rail network is the spine of the study area. WMATA, CSX, VRE, and Amtrak run service through the rail corridor. The rail corridor lies mainly on the eastern side of the study area. Because of its connectivity between the northeastern and southern United States, traffic along this corridor is heavy. Although the large Potomac Yard railyard has been removed, rail lines for CSX still operate on the remaining train tracks. This rail corridor is important for CSX and the greater Washington economy, as it links Washington and points in the Northeast Corridor to points south. Amtrak, by agreement with CSX, uses the tracks for passenger service between Washington and Florida, New Orleans, and San Diego. There is one Amtrak station in Alexandria. This station serves suburban Virginia and offers transfer to local buses and the Metrorail system.

CSX also leases the tracks to the Virginia Railway Express (VRE) for its operations between Washington and Manassas and Fredericksburg. VRE has two stations within the study area, the Crystal City station in Arlington and the King Street station in Alexandria.

Two Metrorail, heavy-rail transit lines, also lie within this transportation corridor. The Blue and Yellow lines traverse the study area between Springfield, Huntington and Washington, DC. Metrorail also allows transfer to other transportation modes such as Amtrak, VRE, MARC, and Ronald Reagan Washington National Airport. Within the study area, Metrorail offers transfers to three bus services:

- Metrobus - providing service throughout the Washington region
- Arlington Transit (ART) - operated by Arlington County (the ART 90 is a shuttle funded in part by Charles E. Smith Companies serving Crystal City)
- Alexandria Transit (DASH) - serving the City of Alexandria.

The study area also contains six Metrorail Stations: Pentagon, Pentagon City, National Airport, Crystal City, Braddock Road and King Street.

Pentagon – This station serves dozens of bus routes operated by WMATA, Alexandria, Fairfax, Prince William County, and the Department of Defense. This station is the largest intermodal station in the region. It is the proposed terminus for any linear transit service within the corridor.

Pentagon City – This Metrorail Station lies approximately 1,500 feet west of U.S. Route 1 and serves the Pentagon City area. Local bus transit service also emanates from this station.

Washington National Airport – The station is located within the study area, but inside of the airport, and is not readily accessible to Crystal City and Potomac Yard. There is only a small amount of Metrobus service to the Airport, and the Station has no park-and-ride, feeder bus, or kiss-and-ride facilities.

Crystal City – This is an underground station in Arlington County. It is the terminus for the ART 90 bus and three Metrobus lines and has no parking or kiss-and-ride facilities. The area that surrounds the station is dense and mixed-use.

Braddock Road – The station is located in the City of Alexandria. Braddock Road station is above ground with bus transfers and kiss-and-ride facilities. Several Metrobus lines, as well as almost all the DASH lines, make stops at this facility.

King Street – This station is located at the southern end of the study area. It is similar to Braddock Road station: above ground with bus transfer and kiss-and-ride lots. There are no park-and-ride facilities. King Street Station is served by all DASH buses, several Metrobuses, Virginia Railway Express, and Amtrak. Because the purpose of the study is to establish connectivity between Braddock Road and Crystal City stations, this study does not look at King Street as closely as the other stations previously mentioned.

Metrobuses traverse the study corridor mostly in a north-south direction, although there is at least one bus line that goes east west. Routes typically take the shortest path through the area. DASH buses connect Old Town Alexandria with the western side of Alexandria.

### 3.1.c. Existing Demographics and Housing

Research on the current demographics was based on 1990 census data (results of 2000 census were not available during the early phases of this study). The current population of the study area is approximately 100,000 people. The study area is made up mostly of low-density residences. Approximately 21,500 households are single-family (attached and detached). About 268 acres of the study area are the remnants of the old Potomac Yard rail yard. The amount of high-density residential development in Crystal City accounts for a significant portion of the residential population in the study area. Thirteen thousand residents live in buildings with 50 units or more (all of them in Crystal City). Within the entire study area, almost 20,000 residents live in buildings with 10 units or more.

As of the 1990 census, Caucasians (not of Hispanic origin) made up the majority of the population (about 64%). The largest concentrations of Caucasians live near the intersection of Interstate 395 and South Glebe Road (Avalon at Arlington Square) in Arlington and between South Glebe and East Glebe Roads in Alexandria. African-Americans (not of Hispanic origin) make up 23 percent of the population, with large concentrations living in the area between Route 1 and Mount Vernon Avenue in Alexandria, as well as the Washington Boulevard corridor. Hispanics make up 9% of the population with concentrations in Pentagon City, the area west of Route 1, and immediately north and south of East Glebe Road.

Vacant land in the study area is scarce and land values are generally high. Consequently, housing costs within the study area tend to be high. The residential development also leads to a demand for services, shopping, and entertainment. A number of areas within the study area provide these services. Near Crystal City lies Pentagon City, a mixed-use development with mid-to-higher end shops and housing. Within Alexandria, is historical Old Town, where shops and mixed-use developments are located. Although many services are already in place, the additional housing in the Potomac Yard area will need to be matched by additional retail and service outlets.

### 3.1.d. Existing Development

The study area is composed of a variety of land uses and densities. Most of the study area is residential and is not expected to change. Commercial development lies along U.S. Route 1, Pentagon City, Mount Vernon Avenue and around the Braddock Road Metrorail station; the existing commercial development is also not expected to change drastically. The largest piece of undeveloped land, Potomac Yard, is the focus of the recent development in

the area. Of the 368 acres of land, 69 of them have been developed as the Potomac Yard Center. This shopping center contains 600,000 square feet of retail, including:

- “Big box” retail (Target, Staple’s, Best Buy)
- Medium-sized retail (TJMaxx, Old Navy)
- A large multi-screen cinema
- A grocery store
- Restaurants
- Smaller boutique-sized stores.

The Potomac Yard Center is located on the northern end of Potomac Yard in Alexandria, just south of Four Mile Run. The Center faces Jefferson Davis Highway (U.S. Route 1), its only means of access and egress. Development, including several automobile dealerships and apartment complexes, has also occurred across from the Center.

## 3.2 DEVELOPMENT OF POTOMAC YARD

The City and the County worked within their jurisdictions to develop the guidelines for their section of the Potomac Yard. Both also worked with the developer to ensure consistency in the development and worked to create a Potomac Yard Plan that would ensure easier implementation of a future transit system that would serve the needs of the jurisdictions as well as the region.

### 3.2.a. Development Guidelines

Alexandria Development Guidelines - Commonwealth Atlantic properties, the owner of Potomac Yard, filed its original application for development of the property with the City of Alexandria. Both the City Planning Commission and the City Council reviewed the applications and established guidelines for the proposed development. Included in the list of guidelines are:

- Design guidelines
- Scale of development (reduced from 6 million square feet to 3.8 million)
- Reserved land for a future Metrorail station
- Open space
- Shuttle/circulator bus operations

During deliberations of the proposed development, the City Planning staff created an alternative concept plan with an alternative alignment for the Monroe Avenue Bridge. The original plan assumed that the Monroe Avenue

Bridge would remain in its current, indirect configuration. The Planning Commission created an alternative that included a new straightened bridge. The decision was made to maintain two bridge scenarios until the City was in a position to decide whether or not to straighten the bridge. Since that time, Crescent Resources, L.L.P. has acquired the property and taken responsibility for advancing the plan and working with the City, County, and State in investigating transit in the corridor.

Arlington Development Guidelines - The development of the “South Tract” is part of Arlington’s Potomac Yard Phased Development Site Plan. This is a plan with a build-out time of 15 to 20 years, with a general plan for transportation, development, utilities, and land use.<sup>1</sup> In order to incorporate the plan, the South Tract land was rezoned from “service industry” (warehousing, bus depot, etc.) to “combination medium residential and low-density apartment-office-hotel”.<sup>2</sup> Improvements to the development range from new bike paths, open spaces, and funding for future transit systems.<sup>3</sup>

### 3.2.b. Future Arlington Potomac Yard North Tract

On the north end of the study area lies the Arlington Potomac Yard North Tract. Although it contains a few industrial uses, this area is mostly vacant. At this time, Arlington County is researching future uses for the site, including recreation facilities of some type. This alternatives analysis takes into account the future land uses of this area for the purpose of determining transit alignments and stations.

### 3.2.c. Future Arlington Potomac Yard South Tract

Potomac Yard Center is the first phase of development in the area. The area left by the former rail line spans two jurisdictions. The northern portion is located in Arlington County, just south of Crystal City. Figure 3-3 shows the land uses within the area of the study and Tables 3-2 lists the land use categories in that figure.

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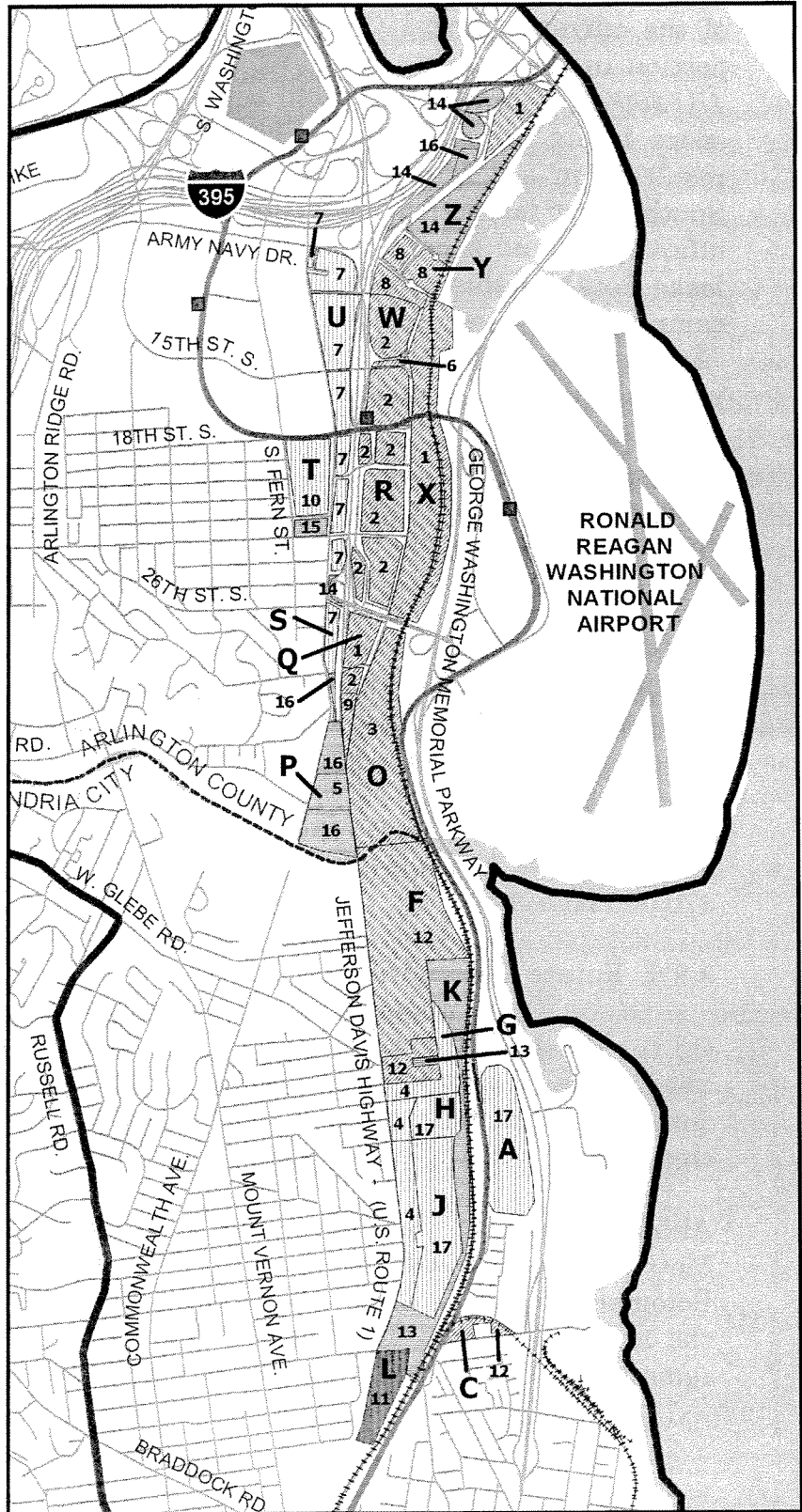
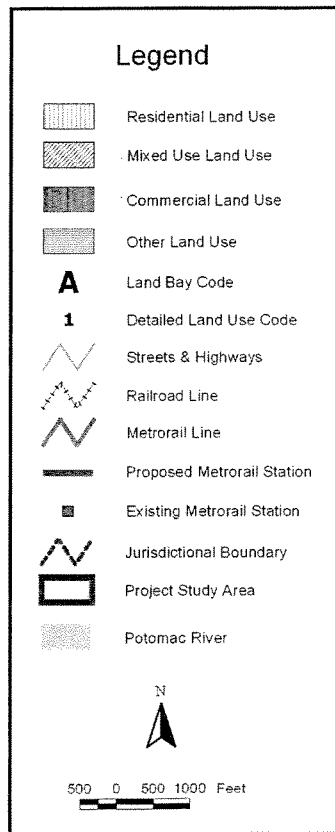
<sup>1</sup> Arlington County, Virginia. (2000). *Potomac Yard Staff Report October 18, 2000* (PLA-2199-CB 10/21/00). Arlington, VA: Arlington County, 10.

<sup>2</sup> *Ibid*, 39.

<sup>3</sup> *Ibid*, 17.

# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig 3-3  
POTOMAC YARD  
DEVELOPMENT PLAN





The Arlington County South Tract will contain a road network that builds off of the current Crystal City network that is compatible with the southern portion in Alexandria. According to the *Potomac Yard Staff Report October 18, 2000*, the South Tract will contain retail, residences, offices, and open space in its six land bays. The area will have a floor-area ratio of 1.5, resulting in a 12-story average building height. The northern end of the South Tract (a portion bordering the established Crystal City) will contain office space and a hotel with a conference facility of at least 50,000 square feet.<sup>4</sup> South of this area will be more office space in a campus setting. The campus setting is intended to attract “very large companies” and expand “Arlington’s competitiveness both regionally and nationally”. The middle area is dedicated to mixed-use residential and office. This area has an open space in the center. The office and retail will be on a street with frontage to Route 1 and Crystal Drive. The buildings will also provide a buffer to the residential buildings located on the east side of the open space. In the southern portion of South Tract, just north of Four Mile Run, there will be a concentration of residential development. Such development “would frame a small plaza or square designed to provide a visual terminus for the extension of the Center Park to Four Mile Run.”<sup>5</sup> As an effort to “animate” the “urban experience” of the area, retail uses are dispersed throughout the South Tract. The majority of retail is located on street-level shops “primarily located at the periphery of the major open spaces of the development.”<sup>6</sup>

The combination of these land uses result in a total gross floor area of 4.4 million square feet (2.8 million office, 1 million residential, 60,000 retail, and 470,000 hotel).

### 3.2.d. Future Alexandria Potomac Yard

On the south side of Four Mile Run is the other, larger portion of Potomac Yard. This section, located in the City of Alexandria already has some development including the Potomac Yard Center, mentioned previously in this chapter and another facility, located South of the retail center.

Although most of the development area is located west of CSX and the Metrorail train tracks, a small parcel of land lies to the east. This area, Potomac Greens, is slated for residential development. Only 40 percent of the area will be developed with townhouses and stacked townhouses. The remaining is reserved for open space and wetlands. Another smaller area

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<sup>4</sup> *Ibid*, p. 47.

<sup>5</sup> *Ibid*.

<sup>6</sup> *Ibid*, p. 48.

(3.1 acres) next to Potomac Greens, on the same side of the rail tracks, is slated for “community serving retail space.”<sup>7</sup>

**Table 3-2**  
**Potomac Yard Land Use Descriptions for Figure 3-3**

<b>Land Use Code</b>	<b>Land Use Description</b>
1	1/3 medium-density residential, 2/3 low-density office-apartment-hotel
2	½ high-density residential, ½ high density office-apartment-hotel
3	1/3 high-density residential, 2/3 high density office-apartment-hotel
4	Apartment
5	Other
6	High-density office-apartment-hotel
7	High-density residential
8	Low density office-apartment-hotel
9	Medium-density office-apartment-hotel
10	Medium-density residential
11	Office
12	Office-retail
13	Park
14	Public
15	Service/commercial
16	Service
17	Townhouse

At the middle of the development (just south of the existing Potomac Yard Center) is the future Town Center, containing 80,000 square feet of retail surrounding an open space. Next to the rail tracks, space has been reserved for a potential Metrorail station. The rest of the area is a mix of residential, office, and small-scale retail. The main body of the yard (the portion North of the Monroe Avenue bridge) contains a mixture of office, residential, and some first-floor retail along Jefferson Davis Highway (U.S. Route 1). Residences are townhouses and stacked townhouses.

In addition, a sliver of land south of the Monroe Avenue Bridge is slated for 319 multifamily residential units and high-density office space.

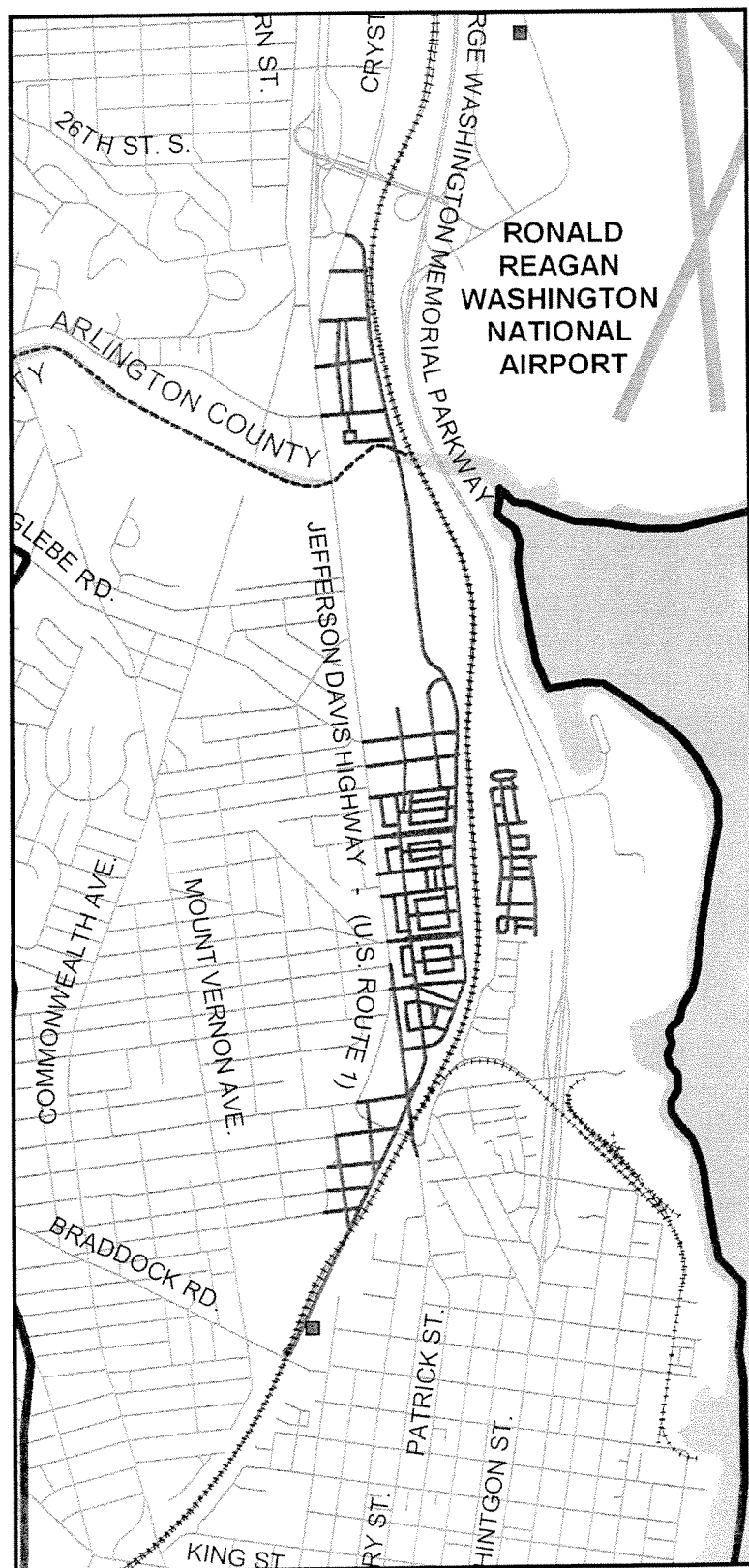
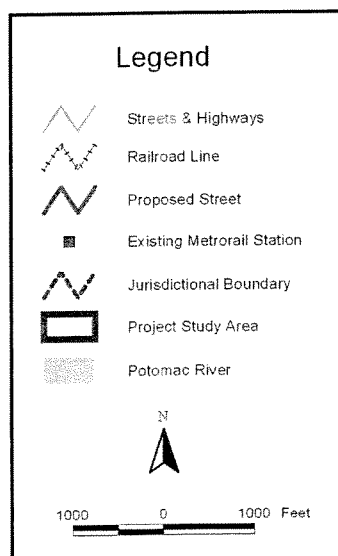
### 3.2.e. Future Street System

Potomac Yard will have a grid system similar to that of Del Ray (Figure 3-4 shows the major and minor routes in the study area). To its west, major east-

<sup>7</sup> City of Alexandria City Council (1999). *City Council Special Meeting Wednesday, September 8, 1999—6:00 P.M. on Potomac Yard/Potomac Greens* (---). Alexandria, VA: City of Alexandria, p. 14, § 3: Staff Analysis.

# Crystal City / Potomac Yard CORRIDOR TRANSIT ALTERNATIVES ANALYSIS

Fig 3-4  
POTOMAC YARD DEVELOPMENT  
PROPOSED STREET SYSTEM



west roads through the new development (Custis, Howell, Swann, and East Glebe) will align with the Del Ray grid, but minor streets will not. A proposed spine road, Potomac Avenue, will run in the rear of the retail center between the big box stores and the cinema. Potomac Avenue will be constructed to parallel Jefferson Davis Highway and is intended to serve as a bypass to U.S. Route 1. Potomac Avenue will be on the far east side of the Yard, just west of the CSX and Metrorail train lines.

Between Jefferson Davis Highway and Potomac Avenue lies a third north-south street, Main Street; this street is intended to serve a purely local function rather than provide convenient through-access. Its cross-section is narrow, approximately 66 feet in width including the sidewalk, and is meant to be a main shopping street for small-scale retail and boutiques. The grid system will continue across Four Mile Run into the Arlington County portion of Potomac Yard. New streets will be constructed in the South Tract with pedestrian areas, bike lanes, and sidewalks.

### 3.2.f. Future Transit System

The Arlington *Potomac Yard Staff Report* makes provision for an exclusive-lane transitway. The transitway will utilize a “shared right-of-way”...transit vehicles will be permitted to cross street traffic at intersections with prioritized signals.”<sup>8</sup> This right-of-way runs from Crystal City south along the east side of Crystal Drive, then turns east and runs along the north side of the extended South Glebe Road, then it turns south on the west side of Potomac Avenue.

This transitway location will provide good transit service to the entire Potomac Yard development, and the location of a station along Glebe Road at the south end of the central open space provides the focus on transit that is necessary for a transit-oriented development.<sup>9</sup>

The initial transitway concept was to construct an approximately 26-foot wide roadway, dedicated to transit, and several transit stations. This concept would accommodate traditional bus transit operations, bus rapid transit, and with some modifications, light rail transit. The construction of the transitway is intended to take place concurrently with the construction of some of the early building projects in the South Tract. Initially, ART and other local transit services that would run on the local streets would utilize it.

Alexandria’s *Potomac Yard/Potomac Greens Proposal* makes only limited reference to transit on the Alexandria side of Potomac Yard. Transportation

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<sup>8</sup> Arlington County, Virginia. (2000). *Potomac Yard Staff Report October 18, 2000* (PLA-2199-CB 10/21/00). Arlington, VA: Arlington County, p.74.

<sup>9</sup> *Ibid.*

Condition 29 requires the developer to operate shuttle bus service to and from the Braddock Road and/or Crystal City Metrorail stations. Subsequent discussions between the developer and the City have directed that service would originate at the Braddock Road Metrorail Station, traveling west on Braddock Road and then turning north onto South Main Street. Beyond the Monroe Avenue Bridge, no specific route was defined.

The new Main Street, a north-south street extending from the Potomac Yard Retail Center to the Braddock Road Metrorail station, was to serve a “proposed shuttle bus service serving the Yard.”<sup>10</sup> The south end of Main Street is a turn around with no access to Braddock Road (after this report, a one-way extension was added to allow vehicles from Braddock Road to enter Main Street<sup>11</sup>).

Transportation Condition 30 (a) of the Coordinated Development District (CDD) Plan requires the developer to reserve an area between Potomac Yard and Potomac Greens for a future Metrorail station. Condition 30 A reserves the City’s right to create a special tax district to support transit and requires the developer to preserve the designated right-of-way for “light rail or another similar transit system.”

### 3.3 ENVIRONMENTAL FEATURES OF STUDY AREA

Review of the environmental features within the study area suggests limited natural and sensitive man-made environmental and cultural resources. While more detailed evaluation will be necessary before transit improvements can be implemented in the corridor, initial investigation indicates that it is unlikely that environmental considerations would be significant.

#### 3.3.a. Prime and Unique Farmlands

No prime or unique farmlands are located in the study area’s highly urbanized setting.

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<sup>10</sup>City of Alexandria City Council (1999). *City Council Special Meeting Wednesday, September 8, 1999—6:00 P.M. on Potomac Yard/Potomac Greens* (---). Alexandria, VA: City of Alexandria, , p. 24.

<sup>11</sup> *Ibid*, p. 27.

### 3.3.b. Soils

Marine clay soils were identified east of Russell Road, south of Glebe Road, and west of Commonwealth Avenue<sup>12</sup>. Marine clays are considered problem soils because they have a high shrink/swell potential, do not drain well, and pose difficulties during construction.

### 3.3.c. Rare, Threatened and Endangered Species, and Natural Heritage Resources

The species indigenous to the study area are not protected under the *Endangered Species Act*.

The Virginia Department of Conservation and Recreation (VDCR) noted that natural heritage resource areas have been documented in the study area. Due to the limited scope of the potential transit alternatives and their distance from the known locations of these resources, VDCR does not anticipate any adverse impacts.

The Virginia Department of Game and Inland Fisheries (VDGIF) noted that the federal/state listed threatened bald eagle (*Haliaeetus leucocephalus*) was identified during a block survey for an area encompassing the project site. VDGIF also noted that “the stretch of the Potomac River adjacent to the project site is a documented anadromous fish use area, and occurrences of striped bass (*Morone saxatilis*), alewife (*Alosa pseudoharengus*), and blue black herring (*Alosa aestivalis*) have been documented”<sup>13</sup>.

### 3.3.d. Water Resources

Several water resources are present in the study area. All of the water resources within the study area lie entirely within the Potomac River Drainage Basin, which is part of the Middle Potomac-Anacostia-Occoquan Watershed.

### 3.3.e. Streams

Long Henry Branch and its tributaries converge in the western portion of the study area to form Four Mile Run, a perennial stream that serves as the

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<sup>12</sup> City of Alexandria, Department of Transportation and Environmental Services. November (1976). *Marine Clay Areas* map.

<sup>13</sup> Virginia Department of Game and Inland Fisheries (2000). *Urban Fishing*. Retrieved January 2002 from [http://www.dgif.state.va.us/fishing/2001TroutGuide/area\\_maps\\_by\\_counties.html](http://www.dgif.state.va.us/fishing/2001TroutGuide/area_maps_by_counties.html)

border between the City of Alexandria and Arlington County. Wetlands are located in the Eastern portion of the study area. There are no trout streams or wild and scenic rivers in the study area.

### 3.3.f. Air Quality

The Virginia Department of Environmental Quality (VDEQ) data indicate that the one-hour ozone standard of 124 parts per billion for Arlington County was not exceeded in the years 2000 and 2001 but that the 8-hour ozone standard was exceeded three times in 2000 and twelve times in 2001.

### 3.3.g. Noise

The study area is located in an urban setting with existing high noise levels, including vehicular traffic noise primarily from the Route 1 corridor, transit noise from the CSX, VRE, and Metro Blue/Yellow line rail corridors, and aviation noise from National Airport.

According to the Federal Transit Administration standards, noise-sensitive land uses in the study area include residential areas along Eads Street (a street parallel to and one block west of Route 1) high-rise apartment buildings located within mixed-use areas, schools, libraries, churches, parks and historic sites.

### 3.3.h. Demographics and Environmental Justice Populations

The study team identified minority and low-income populations in the project study area using guidance provided in the Council on Environmental Quality's (CEQ's) *Environmental Justice Guidance Under the National Environmental Policy Act*. CEQ oversees Federal government compliance with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*. The primary objective of this order is to ensure that the Federal government does not support programs, policies, and activities that have a disproportionate effect on minority or low-income populations.

Using 1990 and 2000 Census data, the study team identified study area Census tract block groups, which are the smallest units for which the Census provides data, with significant environmental justice populations (i.e., minority or low-income populations). Based on CEQ guidance, the environmental sub-consultant identified minority environmental justice populations as those census block groups with a minority population comprising 50 percent or more of the overall population in the block group. The environment sub-consultant identified low-income environmental justice

populations as those census block groups that contain a greater percentage of low-income population than the average percent low-income population of the surrounding City of Alexandria or Arlington County (as appropriate) and the state. The statistical data sets used were *Population by Race* (2000 Census data), and *Poverty Status in 1989 by Age* (1990 Census data). (2000 Census poverty data is not yet available for the City of Alexandria on the block group level.)

- According to the 2000 Census data, minority environmental justice populations exist in 11 Census block groups within the project area.
- According to the 1990 Census data, the poverty rate is generally lower within the study area than in the City of Alexandria or Arlington County as a whole. The poverty rate ranged from 0 percent to 6.2 percent among the block groups in the study area. In 1990, the City of Alexandria as a whole and Arlington County as a whole had a poverty rate of approximately 7.09 percent and 7.13 percent, respectively.

### 3.3.i. Community Facilities

The study area contains several regional parks that serve a variety of functions, including picnic areas, hiker and biker trails, ball fields and other facilities for active sports and recreation, natural areas for passive recreation, and stream buffers to prevent soil erosion. Section 4(f) of the 1966 *Department of Transportation Act* precludes use of park and recreation areas, wildlife refuges, and historic resources for Federally-funded transportation projects, unless there is no prudent or feasible alternative to their use.

### 3.3.j. Cultural and Historic Resources

The Study Team, with the aid of the Virginia Department of Historic Resources (VDHR) and the City of Alexandria's Office of Archaeology, identified known cultural or historic resources in the study area. The amount of historical resources was so large within the study area that only the ones within 100 feet of Tier One analysis corridors were noted.

### 3.3.k. Hazardous Material Sites

In general, EPA and VDEQ list sites they consider to pose significant risk at the time of discovery. The environmental sub-consultants acquired a list of known sites for the study area. However, EPA/VDEQ information indicates that many of these sites have been remediated or are in the process of remediation.



In addition to the known sites, there may be other hazardous sites that would require remediation before they could be used for any purpose. In order to fully identify sites of concern, a full Phase I investigation according to American Society of Testing and Materials (ASTM) standards would need to be conducted.

During the course of transit analysis, the project's technical advisory group identified the Davis Tract, located in Arlington County, as a site with known hazardous material concerns. The Study Team identified Arlington County Board minutes that describe the nature of the concerns associated with this site.

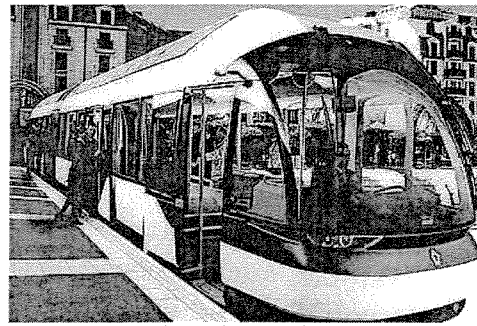
## 4. TRANSIT TECHNOLOGIES

This study examined three alternative transit technologies: Metrorail, bus rapid transit (BRT), and light rail transit (LRT). At project scoping, a number of other modes were considered, but only these three were considered appropriate for the corridor and advanced into study.

These modes are often deployed in places with urban characteristics similar to the Crystal City/Potomac Yard Corridor. These modes are mature technologies employing proven equipment and operating procedures. Each mode has its own unique features, one may be more applicable in certain settings than others, however, each could reasonably operate within this corridor.

### 4.1 BUS RAPID TRANSIT

Bus rapid transit (BRT) is *not* traditional bus service. Generally speaking, bus rapid transit is bus service with enhanced right-of-way, features, and technology that emulates or replicates the reliability, frequency, quality, comfort, and service of a light rail or heavy rail line. Enhanced right-of-way and signal preemption or priority allows the bus to move faster than typical bus service (signal preemption or priority is the minimum enhancement.)



**Bus Rapid Transit – Rouen, France.** Combining an improved quality of service with the flexibility of a bus, BRT is a cost effective alternative to light rail. There are five BRT demonstration lines in operation within the U.S. with six more coming on-line before 2007.

Vehicle Size and Capacity - Currently there are several BRT vehicles, including Irisbus' *Civis* and Bombardier's *Tram-on-Tires*. Depending on the model, BRT vehicles can range from 60 feet (*Civis*) to 80 feet (*Tram-on-Tires*). These models can accommodate between 140 and 160 passengers (including standees).

Average Operating Speed - 15 to 30 miles per hour.

### Right of Way - Bus rapid transit can operate:

- On-street in mixed traffic
- In a separate lane, but shared with buses and/or HOV's (semi-exclusive right-of-way)
- In a separate lane (exclusive right-of-way)

Stations - The size and features of stations can vary depending on the level of investment and level of service desired. In some systems, such as Los Angeles' *Metrorapid*, most stations are modern covered bus shelters. Boston's *Silver Line* has covered stations, automatic ticket vending machines, and platforms for level boarding. No matter how elaborate the station, all BRT stations have the same basic features: real-time information via an automatic vehicle location (AVL) system (to be discussed in the wayfinding section), digital message boards, and a public address system. All of the features are intended to make the BRT experience comparable or better than a journey via rail.

Wayfinding - BRT systems typically have an easy-to-follow signs, maps and information to guide users through a network. Examples of this type of system benefit are the maps, signs, and color-coding in the Metrorail system. BRT would use the same subway-like schematic route maps as heavy rail.

Another wayfinding feature is the automatic vehicle location (AVL) system. These systems, such as Next Bus, use satellite communication and software to locate vehicles and determine the time it will take the vehicle to arrive at the next station. The system will then deliver that information to the public via a station message board or the Internet.

Boarding and Alighting - Traditional buses have front door boarding so the driver can monitor fare payment. Boarding and alighting is difficult for those who are unable to climb stairs, those who use pushcarts, and those who use wheelchairs. All of these situations increase dwell time (how long a bus is at the station). BRT stations have automated ticketing machines, so passengers can purchase tickets before boarding. When the bus arrives at the station, all doors open, and passengers may board and alight through any door. Boarding and alighting is also accelerated with low-floor buses and/or raised platforms at the station. This provides level door access.

Limited Stop Service - BRT is generally faster than normal bus service because it has fewer stations than general bus service.

Special Preference - BRT can also get passengers to their destinations faster because the vehicles are given special preferences. These preferences include

improved roadway from bus lanes on arterial streets, to exclusive right-of-way, such as busways, and exclusive lanes on expressways. Providing traffic signal priority to transit vehicles can also increase operating speeds.

## 4.2 LIGHT RAIL TRANSIT

Light rail transit (LRT) has been described in many ways but usually refers to a vehicle with steel wheels running on steel rails. Power usually comes from overhead wires (catenary). Light rail, sometimes referred to as trolleys, trams, and streetcars, run in mixed traffic (with cars and other vehicles, in exclusive lanes or roadways, or grade-separated from any crossing of general traffic.

Some definitions separate streetcars from light rail, as Mike Taplin, the chairman of the Light Rail Transit Association states, “streetcars are seen to be old fashioned whereas light rail is trendy.”<sup>1</sup> For this study, light rail is assumed to be a steel-wheel on steel-rail system (there are some systems that have rubber tires) with single or multiple cars built after the 1970s (when the first of the modern vehicles were introduced).



**Light Rail Transit – Portland, Oregon.** *There are over 400 Light Rail / Tramway systems operating worldwide, predominately in Europe. 23 cities in the U.S. operate an LRT system traveling a combined 1.36 billion passenger miles each year.*

Vehicle Size and Capacity - An individual articulated light rail vehicle can be as long as 100 feet (London’s *Citytram*). Up to three light rail vehicles can be coupled to form even longer trains. Most light rail vehicles have a capacity of around 160 passengers, including standees. There are some vehicles with a capacity of over 180 passengers.

Right of Way - Like BRT, light rail can operate in any of the following types of right away:

- On-street in mixed traffic
- In a separate lane, but shared with buses and/or HOV’s (semi-exclusive right-of-way)
- In a separate lane (exclusive right-of-way)

Average Operating Speed -15 to 30 miles per hour.

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<sup>1</sup> Light Rail Transit Authority (n.d.). *What is Light Rail?* Retrieved 24 April, 2002 from <http://www.lrta.org/explain.html>.

Stations - BRT stations and LRT stations are virtually identical. LRT stations can vary from basic to elaborate. Although the above-ground stations on Philadelphia's Subway-Surface Lines have covered shelters and platforms, the majority of the stations consist of a signpost. Newer light rail networks have covered platforms, ticket vending machines, AVL systems, and benches.

Wayfinding - LRT stations have enhancements to help passengers find their way through the transit network. Like BRT, LRT also uses subway-like schematic route maps. LRT systems also make use of AVL systems. These systems use satellite communication and software to locate vehicles and determine the time it will take to arrive at the next station. It then delivers the information to passengers through a message board at the station or on the Internet.

Boarding and Alighting - Although light rail is used in tunnels and on aerial tracks, it is mostly used at street level (at grade). Light rail can be placed in the middle or along side an existing roadway, making access to sidewalk venues virtually effortless. LRT stations have automated ticketing machines, so passengers can purchase tickets before boarding. The prepayment of fares allows for faster service. Customers simply proceed to the ticket vending machines in the station where they purchase their tickets. Then the customers can board the train through any door. Boarding and alighting is also accelerated with level door access.

Limited-Stop Service - LRT vehicles can get to its destination faster because it has few stations and it is given special preferences. Station spacing along an LRT route varies from one-quarter mile to one mile, depending on the system.

Special Preference - Another means of providing special preference to vehicles is a method of signal priority, where an LRT-only signal stops all traffic except the light rail.

### 4.3 HEAVY RAIL TRANSIT (METRORAIL)

Metrorail is a prime example of heavy rail transit (HRT). Like most heavy rail, it is completely grade separated (does not mix with other traffic), operates at higher speeds, and has consistent, short *headways* (times between trains).



**Metrorail Blue Line – Washington, DC.** Metrorail serves a population of 3.4 million within a 1500 square mile area. The system operates a fleet of 800 cars on 103 miles of rail network serving 83 stations.

The Washington Metropolitan Area Transit Authority currently operates Blue and Yellow Line service through the Crystal City/Potomac Yard Corridor. Trains stop at Braddock Road, National Airport, Crystal City, Pentagon City and the Pentagon, within the study area. Peak hour headways are approximately three minutes. Regional service extends over 103 miles and 84 stations.

Vehicle Size and Capacity - Metrorail trains can have as many as eight cars, or as few as two. Metrorail currently runs four- and six-car trains.

Average Operating Speed - Along the Blue/Yellow Line corridor, trains operate at an average speed of 33 miles per hour.

Right-of-way - Like most heavy rail, it is completely grade separated, high-speed, and has consistent headways. Metrorail trains can be used underground, at-grade, or on aerials. When heavy rail is used in dense urban areas, it is usually underground.

Stations - All stations on Metrorail have identical features. Every station contains farecard machines (Metrorail's automatic ticket vending machines), fare gates, system maps, neighborhood maps, at least one attendant, a public address system, and electronic message boards. All stations are capable of accommodating eight-car trains when necessary.

Wayfinding - The wayfinding system of heavy rail is the benchmark for the other modes. Signs and placards are uniform so patrons know they are entering or approaching a station. On Metrorail, each rail line is assigned a color and this color is noted on station signs. Maps inside stations contain the entire system as well as a local map to help those exiting the station. Signs in stations have fares to each destination and approximate travel time to it. Electronic message boards within the station indicate the time until the next train arrives.

Boarding and Alighting - Fare collection system provides fast service and allows distance-based pricing. The farecard machines located near the fare gates provide two benefits. The first is the fast boarding and alighting of trains, taking place through all doors. The prepaid farecards are used at the fare gates, so fare collection is not required on the trains themselves. The fare is automatically deducted from farecards upon exit, therefore the price between destinations can vary by distance. Metrorail has also introduced stored-value smart cards. These cards, called SmarTrip by Metro, require only touching sensors at the fare gates instead of inserting a paper farecard, providing even faster fare collection.

#### 4.4 SUMMARY OF KEY CHARACTERISTICS

A summary of the key characteristics of BRT, LRT, and HRT/Metrorail is shown in Table 4-1.

**Table 4-1**  
**Summary of Key Operating Characteristics of Transit Modes**

Characteristic	HRT (Metrorail) <sup>1</sup>	LRT	BRT
Operating Maximum Speed (mph)	59	55	55
Average Operating Speed (mph)	33	15-30	15-30
Minimum Headway (minutes)	3	1½	1
Vehicle/Car Maximum Capacity (no. passengers)	175	180	60 – 160 <sup>2</sup>
Vehicle/Car Seated Capacity (no. passengers)	68 – 81	65 – 85	40 – 70 <sup>2</sup>
Train Size (no. of cars)	4 – 8 <sup>3</sup>	1 – 3	1
Maximum Capacity – One Way (no. passengers)	14,000 – 28,000 <sup>4</sup>	1,800 – 5,400	1,200 – 2,000
Typical Station Spacing (miles)	½ - 1	¼ - 1	¼ -1
Required Corridor Width (feet)	26 – 40	24 – 38	24 - 38

- Notes
1. Actual minimum is 135 seconds. Figures based on the operation of the Blue and Yellow Lines.
  2. Higher end figures assume the use of an articulated bus.
  3. Proposed maximum size of Metro trains in the future.
  4. Figures based on a 3 min headway for a 4 car (existing) and 8 car (future) train.



